THE NAVIGATOR

AFRP 50-3, Volume XXV, Number 1, Spring 1978

NAV OF NOTE

The Air Force Assistant Deputy Chief of Staff for Systems and Logistics is a master navigator who has had a well rounded career. During a recent interview with a NAVIGATOR staff writer, Major General Gerald J. Post discussed his career and his thoughts on how his training as a navigator prepared him for his total Air Force career.

"I think all of us in the Air Force recognize that our job is to be ready to fight and to win. I'm not sure, however, that we all recognize the vital role that resource management plays in achieving and maintaining that posture. Every young officer should be keenly aware of the fact that tighter budgets and fewer resources, coupled with inflation, will likely be the major challenges he will face in his Air Force career. The age-old direction to keep 'em flying—in today's Air Force—requires skills I never thought about three decades ago when I joined the Air Force."

Thirty-four years ago, when Jerry Post, a Braintree, Massachusetts native, enlisted in the Army Air Corps, resource management was not his number one concern. Today, he is Assistant Deputy Chief of Staff, Systems and Logistics, Headquarters U.S. Air Force, Washington, D.C. and resource management is one of his daily concerns.

During his career, General Post has served in three major areas. After enlisting in the Army Air Corps in 1943, he went through aviation cadet training and received a commission and his navigator wings in 1945. He then attended radar, navigation and bombardment training. His first flying assignment was as a radar navigator on B-29 aircraft with the Second Air Force.

In 1946, he was transferred to Europe. "For a young officer, the Air Force was really exciting. My first overseas post was Paris, France," said the General. "A year later, I was in Rhein Main, Germany, serving as a navigator and route briefing officer with Military Air Transport Service (MATS)."

From December 1952 to June 1953, during the Korean War, he flew 50 combat missions as a member of the 13th Bombardment Squadron at Kinsan, Korea. "As a reward for my Korean service I was sent to Mather AFB as a navigator instructor and operations officer," said General Post. "That period in the 3535th Navigator Training Wing, principally as a teacher, became an important part of my professional education."

After three years as an instructor, General Post's career took a new turn. From September 1956 to June 1958, he attended the University of Chicago as a graduate student in business administration under the AFIT program. The General noted that "...it was quite a change in roles for a young officer. For three years, I was the instructor and felt very comfortable in that role. Suddenly, I became a student; a humbling experience." Upon graduation the General was selected to be a member of Phi Beta Kappa and Beta Gamma Sigma.

"Graduation was another turning point in my career," said General Post. "I was to begin a second Air Force career in the comptroller field." General Post was assigned to Lincoln AFB, Nebraska, as a Strategic Air Command wing management analysis officer and later was comptroller for the 307th Bombardment Wing. During the next three years, he also qualified in the B-47 and KC-97 aircraft.

In 1961, General Post, then a major, entered the Air Command and Staff College at Maxwell AFB, Alabama. His next assignment was to Tachikawa Air Base, Japan, where he served as Chief of Management Analysis and later as Chief of the Budget Division for the Kanto Base Command.

"Just as I was beginning to really understand the budgeting area, my tour was up," said General Post. "To my surprise," he continued, "I was sent to the Pentagon as a branch chief in the Management Information Division in the Management Analysis Directorate of the Comptroller."

He continued in the analysis career area after attending the Army War College and being assigned to Air Force Logistics Command (AFLC) as Director of Cost Analysis. In June 1970, he was transferred to the San Antonio Air Materiel Area (SAAMA), Kelly AFB, Texas, as comptroller.

In 1971, General Post began his third career in the Air Force. He became Director of Materiel Management at SAAMA, responsible for worldwide logistics support of 20 different types of aircraft as well as all aerospace ground equipment and life support equipment.

From Kelly AFB, Texas, in April 1973, General Post moved to AFLC Headquarters as Assistant Deputy Chief of Staff, Materiel Management. Five months later he became the Deputy Chief, Materiel Management. He served in that position for two years before becoming AFLC's Chief of Staff.

In 1977, he moved to Washington as Director of Logistics Plans and Programs and later Assistant Deputy Chief of Staff, Systems and Logistics.

"My Air Force experience has consisted of three quite different careers," said the General. "As a young officer, I spent my formative years, eleven in all, as a navigator. The discipline and training as a navigator certainly helped during the next thirteen years in the comptroller area. These two exacting disciplines prepared me for the latter part of my career in logistics. I doubt if I would have had such an opportunity in any place other than the Air Force."

General Post is a master navigator whose decorations include the Legion of Merit with one oak leaf cluster, Distinguished Flying Cross, Meritorious Service Medal and Air Medal with two oak leaf clusters. He is married to the former Janes S. Curry of Quincy, Masachusetts, and has seven children. Three of his sons are serving in the Armed Forces.

"If I had it all to do over again," said General Post, "I wouldn't wish to change a thing—except perhaps spend a little more time in Paris and a little less time in Washington.

"I view my navigator experience as the watershed of my career. The discipline, training, and attention to detail instilled in me as a junior officer have enabled me to manage resources better—and as I noted earlier—resource management is what it's all about in today's Air Force."

From The Editor

MEET YOUR NEW EDITOR: Captain Steven Hurwitz is a 1967 graduate of Rutgers University where he majored in psychology. He was commissioned in 1967 at Officer Training School and then attended the Aircraft Maintenance Officer Course at Chanute AFB, Illinois. After a year at Byrd Field, Richmond, Virginia, he went to UNT and NBT at Mather AFB, California. During five years in the B-52Ds, Captain Hurwitz flew from Dyess AFB, Texas, Anderson AFB, Guam, and U-Tapao RTN, Thailand. Immediately before becoming the editor, he was an NBT instructor at Mather. Captain Hurwitz is a senior navigator with 2,800 flying hours.

THE NAVIGATOR is a top-flight magazine because of you. Your comments, your suggestions, and your articles for publication make up the bulk of THE NAVIGATOR. I solicit your continued interest—and manuscripts. Thumb through this edition, and you'll see that we publish various kinds of articles. One reason is that the navigator's job in any one aircraft seems so different from other aircraft. And so we enjoy reading about the navigator's job in the U-2 (page 5) and the KC-135Q (page 22). New equipment such as Omega (page 24) and the E-3A (page 12) seem intrinsically interesting while assignment prospects "End of Tour Report", (page 26) may be the most popular topic of all. We also enjoy reading about the successful careers of the officers featured in the "Nav of Note." I encourage you, as you read this edition, to think about what you'd like to communicate to your fellow professionals. Then send your comments and articles to:

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Nav Calculator Formulas Update

Captain James J. HAIRSTON
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Mather AFB, CA

Correspondence from my calculator-using friends has included ways to improve the results from the formulas I presented in the Winter issue of THE NAVIGATOR.

My formula for coriolis was correct, but provided an adjustment to the HO. If you, instead, choose to adjust assumed position for coriolis, use:

coriolis = .02625 x GS x SIN (LAT)

For combined coriolis/rhumbline adjustment to assumed position use:

coriolis/rhumbline = [.02625 x GS x SIN(LAT)] + [(.146 x $(GS/100)^2$)(SIN TC)(TAN LAT)]

To apply coriolis/rhumbline correction to HO, multiply coriolis/rhumbline by [COS(90-(TC-Zn))]. Note that P and N adjustments are not necessary with these computer applications since HC is correct for fix time not HO 249 EPOC year time.

For in-flight w/v determination the formula for wind velocity should read:

$$v = \sqrt{GS^2+TAS^2 - [2(GS)\ (TAS)\ (COS\ DCA)]}$$

For the TAS calculation, I incorrectly stated that temperature rise for most aircraft is -1°C. Actually, CT is +1°C for most aircraft.

I hope this will clear up any problems you had. Keep on calculating and navigating!

THE NAVIGATOR

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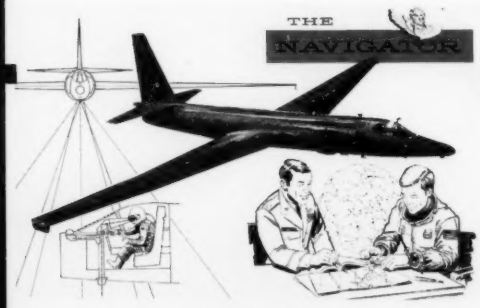

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A navigator in the U–2? Our cover article, starting on page 5, discusses the role of the staff navigator in the mission of that unique aircraft. "AWACS–Where the Action Is," page 12, deals with a plane that is equally interesting, but considerably newer.

Everything You've Always Wanted to Know About A U-2 Navigator But Didn't Know Where or How to Ask!

Major Phillip L. JARVINEN
9 SRW/DOX
Beale AFB, CA

It's a safe bet that a sizable number of Air Force navigators today have heard very little about the unique, high-flying U-2. Those who have a little knowledge of this strange craft probably have had their concept of its role influenced by the international incident caused when the late Francis Gary Powers' U-2 was downed over Russia in 1960. Through the years, however, many applications of this unique airframe have evolved around nonpublicity producing "low profile" operations.

Since very little has been published about the craft over its more than 20-year history, few navigators are aware of the opportunity that exists within SAC for a staff navigator in the U-2 reconnaissance program. While the organization is rather small, being limited to one squadron at Beale AFB, California, it is an elite group that reaps the rewards of highly successful mission results. This article will focus on some of the U-2 operations, discuss some general mission planning procedures, and briefly outline the career broadening aspects of the U-2 navigator assignment.

Let's begin by clarifying the role of the navigator in the U-2 program. As you might guess, he does not regularly fly in the aircraft as a crew member. Although a few dual-seat U-2s have been built, they serve as pilot trainers. It is safe to say, however, that every U-2 flight above 60,000′ could not be successfully accomplished if it were not for the exacting and diligent efforts of the U-2 staff navigator. The basic role of the U-2 navigator is accurate and detailed mission planning. While this doesn't sound much different from the usual navigator role, in the U-2 program it leads down a very interesting path.

To understand the navigator's special responsibilities and problems associated with the U-2 program, some background information on the airframe and its equipment may be useful and revealing. It first flew in August 1955, and has been in the inventory ever since. Its role was, and still is, to function as an extremely high-altitude reconnaissance platform. While the external design has changed very little, the U-2 has been reworked internally many times to improve its capabilities and cost effectiveness.

An initial close-up inspection of the U-2 can leave an observer with quite a varied impression. It lacks the enormous size of a B-52 or C-5. In fact, an entire squadron of U-2s could probably fit inside one C-5! It doesn't have the super-sleek lines of an F-15 or B-1, but rather appears a basic and straightforward design. The fact that it has operated continuously above 60,000′ longer than any other aircraft in history is hidden in its simple lines and flat-black paint. The long, thin, high-lift wings with their tip skids droop nearly to

VIEWSIGHT CUT-AWAY

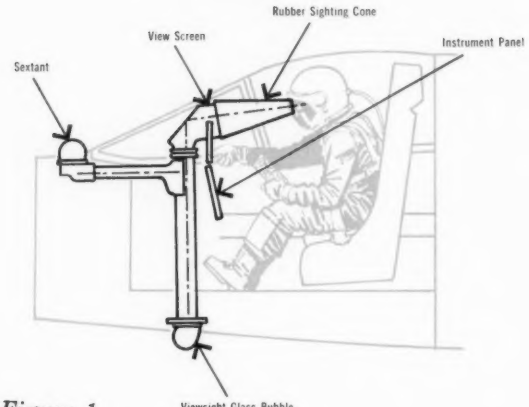

Figure 1

the ground. They are supported by plug-in "pogo" wheels that drop off early in the short takeoff roll as the wings develop lift. The retractable bicycle-style main landing gear and solid steerable tailwheel appear somewhat inadequate and require that the pilot be adept at performing a delicate balancing act on every landing. Peering into the intakes reveals an impressively large nonafterburning engine. Over the cockpit area, a fiberglas sunshade is mounted inside the canopy to protect the pilot from ultraviolet radiations and minimize glare at extreme operating altitudes. Outside the cockpit is a rearview mirror and a section of cord called a "yaw string," used to detect yaw axis motion during flight. While the long, slightly drooping nose gives the bird a rather mysterious look, the overwhelming impression that the U-2 is a highly powered "glider" is inescapable!

Climbing up the "how-dah," a specially designed stand with a canvas canopy to shade the pilot and cockpit area during preflight, it's possible to look into the "office" of the U-2. A quick glance around the cockpit shows groupings of instruments that could be found in most any modern day jet. There are few "frills"—things are kept simple and basic, primarily because of weight considerations. While there are a few unique mission-related instruments, everything is impressively compact. In fact, the small size of the cockpit is most striking. Every pound of excess weight means a penalty in altitude or payload on an operational mission.

Directly above the control yoke, in the center of the instrument panel, is a telescoping rubber "sighting cone," very similar to the light shield on a radar or Loran set. This device is the cover for the "viewsight," a cockpit-controlled scanning prism and mirror arrangement that allows the pilot 360° visibility under the aircraft and has varying optical powers. In simpler terms, it is little more than an upside-down periscope very similar to a navigator's driftsight. (See Figure 1, Viewsight Cutaway.) The viewsight is used by the pilot to aid his map reading from operational altitudes above FL 600. This prism and mirror arrangement is combined with a sextant to allow celestial observations through the same viewing screen. It is this viewsight, combined with little more than a compass and clock, that comprises the basic navigational aids of the U-2. But what else is necessary to accomplish basic dead reckoning?

While the pilot has a few additional back-up nav aids, such as a Tacan and either a sextant or an inertial nav system, the primary, and seemingly unsophisticated, method of navigating to an area of interest (AOI) and successfully accomplishing the mission is little more than precise DR. Combine this rather "primitive" navigation, cramped cockpit environment and an astronaut-style full pressure suit, and the need for accurate and detailed mission planning by the U-2 staff navigator becomes obvious.

When the pilot takes off on a high flight mission profile, the refined and specialized materials he carries represent long hours of careful work and many cross checks by the navigation section. The variety of mission profiles requiring the navigator's expertise have, in the past, included photographic reconnaissance, atmospheric sampling and research, search and rescue support, and the special testing of equipment for research and development.

To accomplish these missions, the U-2 staff navigator's background must be broad and varied. This experience allows tailoring the actual mission materials to the pilot in his unique environment. Just as the basic method of navigation in the U-2 is "simple," the basic task of the mission planner is—on the surface—surprisingly simple. The simplicity disappears, however, when the full variety of sensor systems and possible mission profiles are investigated. At times, the primary rule of "keeping it simple" threatens to become an impossibility.

In this article, a typical mission will be described. The project is typical of the tasks accomplished on a daily basis by the U-2 flying routine training missions. Periodically, the U-2 is tasked to assist in area surveys over specific military training areas of the United States. The purpose of these surveys, called mapping, charting, and geodesy (M, C, and G), is to provide

update material for use by SAC during Operational Readiness Inspections (ORI) and TAC during low altitude training missions. These low-level charts, commonly known as the "200 Series," are quite familiar to bomber crews. The M, C, and G projects cover proposed ORI routes and are usually completed shortly before the route becomes operational. General coverage of the entire low level operations area is accomplished on one portion of the survey. Specific photography of the SRAM launch areas and the bomb run/maneuver areas is done on another portion of the survey. The area usually covered on this combined project easily exceeds 50,000 square miles.

For some portions of M, C, and G, a sensor configuration called the "A-2" is used. It consists of three relatively long focal length cameras arranged in a single mount to provide vertical and oblique photo mapping coverage with varying amounts of overlap. Other portions are flown with a four-camera sensor called the "A-1,"—three relatively short focal length cameras for vertical and oblique coverage and a long focal length "rocker" camera for more detail. The U-2 navigator's job now becomes one of economy and efficiency. How can the job best be done to minimize film expenditure and flying hours, and maximize training for the crews? (See Figure 2, Camera Coverage.)

CAMERA COVERAGE

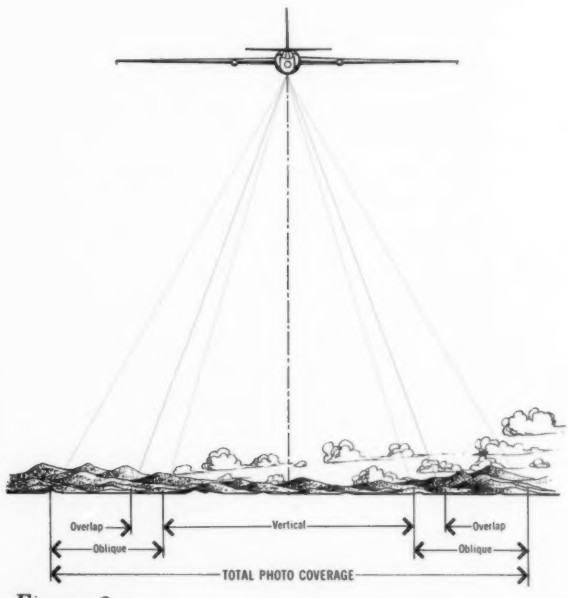

Figure 2

As with any aerial photography, weather is an important consideration. For U-2 photo missions, cloud coverage in the area of interest must be 2/8 or *less* for acceptable photography. To provide an adequate forecast, the base weather shop, working with SAC Global Weather Central, provides a daily special U-2 cloud and wind forecast for the entire U.S.

The actual "nuts and bolts" mission construction begins with a favorable weather forecast. Appropriate scale charts are used for each segment of the mission. For navigation to and from the photo area a standard jet navigation (JN) chart is used. In the photo area itself, an operational navigation chart (ONC) is normally used because its scale closely matches what the pilot sees through the viewsight from altitude. Occasionally, a tactical pilotage chart is used for photo work. The actual mission planning tools used by the navigator are quite standard, a plotter, dividers, MB-4 computer, and a special plastic template with various circle sizes depicting turning diameters of the U-2 on various scale charts.

With the basic tools assembled, the navigator lays out the entire mission in pencil. A planning worksheet is used for preliminary measurements of courses, distances, fix points, etc. After this rough draft of the entire mission is finished, it is closely checked by another navigator. Accuracy tolerances are ±1° for courses, ±1 nm for distances, and ±30 seconds for enroute times.

The mission profile for our example probably would start with a nav leg out to the photo area. This nav leg could be either celestial or dead reckoning. In either type of leg, the procedures are matched and tailored to the man in his environment. The methods used have many variations and refinements, but the basic procedures have proven adequate for the U-2 over the years.

Regardless of the type of navigation leg being flown, two assumptions are made for U-2 navigation. Groundspeed will remain constant and if off course, all alter headings will be made to return to track. The first assumption is valid because normally the winds above FL 600 are light and variable, so TAS approximates groundspeed. The second assumption is important because "on track" is where you want to be.

For celestial navigation, the planner will develop a nav leg, usually 1½ hours long, using most probable position (MPP) procedures. Since the U-2 pilots are not trained as extensively in

celestial procedures as navigators, some special techniques are used. Heading checks and MPPs are carefully planned and average about twenty minutes apart. The planner will determine fixed DR positions at optimum pacing points and compute all celestial data for these positions based on on-time takeoff. The departure route will have a built-in time delay so the pilot can control his nav leg departure for minor takeoff delays, but for delays over a half-hour an automatic two-hour delay is taken so the navigator can recompute the celestial data.

At the preplanned fix positions, the nav will compute and plot all essential data for the MPP, including Hc, motion adjustments, Zn and observation times. This information is then transferred to the celestial fix tab near the MPP point. Normally, the pilot will shoot three one-minute observations: 4 minutes early, 2 minutes early and on time. He records the Hs, applies the motion adjustment to compute the Ho and averages his results. He compares his average with the Hc and plots his LOP parallel to the navigator's preplotted LOP using the familiar "HOMOTO Rule."

If the pilot is a few minutes early or late at the "Start Nav Leg" point, he adjusts the preplanned DR positions using the "7 nm/min" guide and makes his observations at the preplanned times. The MPP by definition lies on a perpendicular between the LOP and DR position, and the pilot uses his judgment in weighting his results. Generally, more weight is given to the DR position early in the nav leg, with more weight to celestial results later. Also, a heading check is made at each MPP during the "on time" observation.

If the pilot determines he is off course, he will compute an alter back to planned track using one of the following methods:

Method I. If distance off-course is 10 nm or less:

Step A: Measure distance off-course and multiply by two.

Step B: Start timing and simultaneously turn aircraft toward desired track the same number of degrees computed in Step A.

Step C: Fly this heading for 4½ minutes and then turn back on desired heading. No ETA adjustment is required for this turn.

METHOD II. If distance off-course is 11 nm or more:
(U-2 Checklist Supplement)

OFF-COURSE CORRECTION TABLE
(45 Degree Method)

NM OFF-COURSE	TIME TO FLY (min)	ETA ADJUST TIME (min)	DR ADJUST NM
12	2½	½	4
14	2¾	¾	5
16	3¼	¾	6
18	3½	1	7
20	4	1	7
22	4½	1	8
24	4¾	1¼	8
26	5¼	1¼	9
28	5½	1½	10
30	6	1½	10

Step A: Start timing and simultaneously turn 45 degrees toward desired track. At expiration of "Time to Fly," initiate roll-out on course. All turns made with steering "bug," approx ½ deg/sec turn rate.

Step B: Algebraically apply DR adjustment to position adjust to find the total correction for the next preplanned fix.

Step C: If position is used to update an ETA, algebraically apply ETA adjust to computed ETA.

During the 1½ hour nav leg, the planner usually precomputes three MPP points plus heading checks for departure, each MPP, and after each planned turn point. In actual operation, the celestial results obtained using these rather basic techniques are remarkable considering the environment, which has been compared to navigating from inside a "pressurized goldfish bowl" in constant worry of dropping a pair of dividers on the pressurized gloves!

After the last MPP, the planner usually allows a "coasting period" of about 15 minutes until nav leg termination so the pilot can transition to the next mission task. During this period, the pilot will use his viewsight to determine a visual estimate of his circular error, weather permitting, and back it up with a Tacan position. The navigation leg will also be photo-scored using a constantly running 35 mm or 70 mm "tracker camera" that was turned on just before departure from home base. Normally, the nav will plan termination over an easily identifiable spot to assist scoring and then provide another 5-10 minutes of deadhead time into a Vortac for pilot reorientation.

If a nav leg is planned out to the photo area, procedures are considerably easier with less computations for both the planner and the pilot. A DR leg, usually one hour in duration, is laid out in about the same manner as a celestial leg. The purpose of a DR leg is to develop the pilot's ability to DR and uses fixes coinciding with Tacan positions and ground references. Basically, the navigator will select fix points approximately every 20 minutes on the track to coincide with viewsight fixpoints and cross them with a Tacan range and bearing. Essentially, the pilot makes the departure point good, flies the preplanned heading for the specified time, and logs a fix when the planned radial and DME appear. He will cross check the fix with a viewsight observation and alter back to course, if necessary, using the same procedures previously discussed. The nav planner will use DMEs over 60 nm when possible to minimize slant range errors, and fixes will be planned as close to abeam the station as possible. After the last planned fix, a coasting period and deadhead leg are used for termination and reorientation.

Photo flight lines (PFLs) inside the area are planned with either a north/south or an east/west orientation for maximum use of section lines and road trends. The outline of the photo area is depicted on the JN chart for broad reference with the entry and exit points, and the actual PFLs are shown on an ONC. For a normal M, C, and G project like the example, the PFLs will be 12 nm apart which will allow sufficient oblique and vertical coverage. Ends of the flight lines are extended about 7 nm beyond the edge of the area to allow the pilot time to reorient for each run. Visual checkpoints, pointer systems, and time-tick marks are commonly used methods of increasing navigation reliability. However, when good references are not available, good DR must be used. The delay in the photo area is usually many hours. Occasionally the mission must be cut short so that the pilot can return to base to avoid violating his 12 hour flight duty period.

The route home is usually direct and may include another nav leg or additional flight photography for training. The typical U-2 mission duration is about seven hours, with the navigators spending approximately 10 hours planning and briefing it in minute detail.

Once the rough draft described earlier is finished, the final details and chart "beautification" are completed. The final flight plan is drawn up on a light cardboard "Green Card," so-called because of its nonreflective green color. The card contains virtually all the information necessary to fly the mission: headings, reporting points, action points, fuel curve, oxygen curve, etc. All the mission charts are trimmed to 14″ x 10″ format, numbered sequentially and mounted on rigid cardboard to preclude dropping when the pilot wears his bulky gloves in flight. All heading information is also depicted on the charts for convenience. When the entire mission is "boarded" and beautified, two navigators use a comprehensive checklist to insure accuracy and completeness and that the pilot is thoroughly briefed on every aspect of the mission.

From a career broadening standpoint, the assignment as a U-2 staff navigator can hardly be matched. It is truly a unique and interesting job with a very select group. Most navigators assigned to the squadron have between 9 and 16 years service with a varied operational background. The U-2 missions demand an expertise that not every nav possesses, but the opportunity to learn is great. Currently, seven navigators are assigned to the navigation section of the 99th Strategic Reconnaissance Squadron, the only U-2 unit in the Air Force.

The consistently outstanding results of important missions provide the navigator visibility at many levels of command and add to the job satisfaction. To be considered for the assignment, flying time gates should be met up to at least the nine year point. Each application is screened by the 9th Strategic Reconnaissance Wing staff and the 99th Strategic Reconnaissance Squadron to insure adequate background, flying experience, and potential. After signing in, the navigator enters a 4-6 week checkout period during which he learns the basics of U-2 planning through on-the-job training.

Navigators who have "made the team" and participated in the diverse range of U-2 operations have invariably considered it the most gratifying experience of their Air Force careers.

Major Jarvinen, a 1965 graduate of the University of Wisconsin, Superior, was commissioned through AFROTC. After UNT and NBT, he served a SEA tour in EB-66s, followed by assignment to B-52s at K. I. Sawyer AFB and Arc Light operations. Transferred to Mather AFB in 1971, Major Jarvinen was an NBT instructor until 1975 when he entered the U-2 reconnaissance program. He currently serves as Chief, SR-71 Missions Section, Beale AFB.

B-52 EWO TO UNT INSTRUCTOR

An Experience in Job Enrichment

Captain William M. WANSER
452 FTS
Mather AFB, CA

"Pilot, come right to a heading of 052° and increase the indicated airspeed to 445 knots."

"Roger, nav, coming right to 052° and increasing indicated to 445."

"Pilot, we'll be coming up on our next turn point in approximately two minutes. At that time we'll be coming right to a heading of 094° and climbing to an altitude of 5,700 feet. The approximate time enroute will be 10 minutes and 43 seconds. The highest obstruction will be a 4,200 foot ridgeline to the left of track about three quarters of the way down the leg."

"Roger, nav."

"Pilot, I'd like a fuel reading."

"We have 9,600 pounds, nav."

"Pilot, I have us at the turn point, come right to 094° and climb to 5,700 feet."

"Roger, nav, right to 094°, climbing to 5,700 feet."

Less than a year ago, I was in a B-52 flying a low level route and the same type of communication sequence was in progress, but there were some major differences. I was not the pilot, whose role I often play. Nor was I the navigator, whom I now instruct. I was the Electronic Warfare Officer and that conversation was, to me, little more than background noise.

"Pilot, come right to a heading of 121° and decrease the indicated to 430 knots."

"Roger, nav, right to 121°, decreasing indicated to 430."

While a primary concern of the pilots and navigators aboard the B-52 was heading, altitude and airspeed, I was concerned with the montage of visual displays and sounds coming from my warning receivers. Rather than think of low level routes in terms of checkpoints and time control, I thought of enemy defense structures, electronic countermeasure action points, and enroute and target threat radars.

"Pilot, in approximately two minutes we'll be at the next turnpoint. This will be the leg to the target. We'll be coming left to a heading of 073° and descending to 3,700 feet. The approximate time enroute will be 11 minutes and 14 seconds and the highest obstruction along this leg will be a 2,200 foot peak right of centerline just prior to the target."

"Roger, nav."

This major job change came about through a PCS from the 596th Bomb Squadron at Barksdale AFB to the 452d Flying Training Squadron, a UNT squadron at Mather. Now, nine months later, I am a simulator console instructor, seated behind the controls of the multimillion dollar T45 simulator, instructing four UNT students in advanced low level techniques.

The typical advanced low level mission flown in the T45 simulator approximates the airspeed and performance characteristics of an FB-111. The mission begins with a preflight of the navigation equipment. The student is responsible for all ground and airborne communications. He has control of his own "aircraft" and can fly from sea level to 70,000 feet at airspeeds from 0 to 2.0 Mach. Turn, climb and descend rates are also controlled by the student. The ground portion is followed by takeoff and a student-directed SID. He has Tacan, VOR, radar, a nav computer system and an INS available to direct this SID.

Once the SID is completed the student begins the high level portion of the mission. Training in time control (he must make the primary entry control point [PECP] within ± 2½ minutes) is compounded by additional training in weather avoidance and penetration. Prior to reaching the PECP he requests low level clearance from the controlling agency. He is given clearance and altimeter settings for entry, midpoint and exit. Prior to the low level entry point, he must configure his radar in sector scan, depressed center to more closely simulate the FB-111/F-4 type aircraft. During the low level portion of the mission he is graded against very stringent

criteria. To receive a grade of excellent, he must maintain average time control of ± 30 seconds to each checkpoint and the target. The aircraft must be aligned to within 1 nm for the entire leg. Any violation of the 4 nm corridor on the student's checkride results in an automatic "unable" grade for the mission.

The T45 simulator is an excellent aid to instruction. The CRT display, available at two positions behind the control console, allows the instructor to monitor the student throughout the entire mission. A display is provided for each student's aircraft parameters and environmental factors such as wind and barometric pressure. The instructor can, at a glance, extract the student's altitude, airspeed, heading, altimeter setting and ETE to the next checkpoint. This is only a small sample of the information available for the instructor's use. There is also a graphic display of the student's aircraft position relative to the flight planned route. The display can represent either a 40 nm x 40 nm or a 200 nm x 200 nm area. It is the state of the art in navigation simulation and instruction.

The transition from a B-52 EWO to a UNT instructor has been an experience in job enrichment. The B-52 navigator and electronic warfare officer wear the same wings but that is where the similarity ends. As a B-52 EWO you are responsible for the protection of the aircraft against the multitude of threats in a hostile environment. To perform these duties you need a thorough knowledge and understanding of the enemy's defense structure. This knowledge must include the organization and responsibilities of the controlling agencies, the performance characteristics and capabilities of defensive weapon systems including antiaircraft artillery, surface to air missiles and the airborne interceptor force, and the capabilities of your equipment against these threats.

Basic navigation is an entirely different type of discipline. Once the basic fundamentals have been learned, the major task is applying them to new situations whether they be navigation problems or new navigation equipment. This is quite evident in the UNT program. The students learn the basic fundamentals very early in the program. Then they learn to apply these basic fundamentals to new fixing techniques and new navigational equipment.

Having been out of the navigation business since graduation from UNT about four years ago, I approached the new assignment with some apprehension. To qualify as a UNT instructor, new personnel must attend Instructor Training School. This three-month school is divided into three phases: academic instructor, T-43 navigator, and T-43 instructor. I thought the program was excellent. As a UNT instructor, you are called upon to teach in three major areas. The first is platform instruction. Each instructor has an academic speciality he teaches in the classroom. Prior to teaching his first class each instructor must "follow-on-train" with an instructor who is experienced in that particular academic speciality. This consists of sitting through an entire presentation of that phase of instruction. The instructor also teaches in the T-43 aircraft and the T45 simulator, instructing all phases of the UNT program including Navigation Systems (Radar), Celestial, Global, Grid, and Low Level.

A year ago I had no idea that I would be required to develop expertise in all phases of navigation for my next assignment. When I graduated from UNT I neatly packed my plotter, dividers and computer away assuming that as a B-52 EWO, I would never have occasion to use them again. I could not have been more wrong. I am not only using them myself, but instructing others to use them.

What has happened to me in the past year has made me keenly aware that as Air Force navigators, we must be prepared for duty in any weapon system or position that our navigator rating qualifies us for. The past nine months have been very fulfilling. The initial feeling of apprehension has given way to a feeling of confidence in my ability to instruct the Air Force's future navigators. The opportunity to work in these diverse fields has been very challenging. Yes, from B-52 EWO to UNT instructor has been an "experience in job enrichment."

"Pilot, come left to 119°, we're about three minutes out from the target."

Captain Wanser graduated from Defiance College in Ohio and completed OTS in 1971. Following UNT and EWO in 1972, he served in B-52s at Barksdale AFB and instructed electronic warfare training. In 1976, Captain Wanser was assigned to the 452 FTS, Mather AFB, as Navigation Procedures Instructor.

AWACS-

Major Thomas A. SCHUMACK
966 AWAC Tng Sq
Tinker AFB, OK

One of the newest, most exciting weapon systems entering the Air Force inventory is AWACS, the acronym for Airborne Warning and Control System. The name itself suggests an important, dual mission—airborne warning for surveillance, and control, for "command and control," consolidating and directing our airpower in a variety of missions.

AWACS is housed in a modified Boeing 707-320B with the military designation E-3A. On top, the 30 foot "rotodome" contains the surveillance radar and IFF antenna systems which give the aircraft its distinctive appearance. The aircraft also was modified by adding an in-flight refueling capability and more powerful engines. Both extend operating range and on-station time.

Other major subsystems include the surveillance radar, communications gear, data processing computer, data display and control equipment, and the navigation system. The surveillance radar uses a pulse Doppler as well as a conventional pulse mode which operate much like any modern ground-based radar. It consists of a radar transmitter and phased array antenna. Mounted on the back of the radar antenna is the IFF/SIF antenna array, providing positive identification of friendly aircraft.

The extensive communications equipment is unique, and includes a variety of UHF, VHF, and HF radios which link AWACS to air and ground counterparts in the tactical theater. Besides standard voice communications, there are secure voice and data link capabilities.

The "heart" of AWACS, or more appropriately the "brain," is the on-board computer known as "4Pi." The computer integrates and processes data from the subsystems for real time display of the tactical environment. The 4Pi also uses memory data to enhance radar target returns, identify and flag targets, and even simulate a tactical situation on the data display consoles. It can also transfer information to another AWACS aircraft via data link when leaving station, so each relief crew doesn't have to rebuild the data base. This advantage insures operational continuity for extended periods.

The weapons control, surveillance, and battle management functions of AWACS are performed using nine identical data display consoles, configured by the operator to handle surveillance, aircraft control, or battle management, plus display tabular data.

The AWACS Navigation Computer System (NCS) includes two independent inertial systems aided by a Doppler radar and Omega Very Low Frequency (VLF) positioning system. The inertial navigation system (INS) is the standard Carousel IV, widely used in commercial aviation. The Doppler radar and Omega receiver, although independent units, are integrated through the Omega computer and use the NCS control panel for system control and data display. The Omega computer uses a Kalman filter to evaluate and compare data from the Doppler and Omega as well as true airspeed, altitude, and magnetic heading from aircraft instruments to determine position error. The position error is used to bias and correct each INS position, thereby reducing the cumulative drift error associated with INS navigation systems.

The accuracy of the NCS depends on the mode of operation selected by the navigator. Normal operating mode is Doppler-Omega-inertial, with the inertial position continually updated or "aided" by Doppler and Omega data. Since each inertial system can operate independently, one

system may be "split" from the NCS and operated as a free-running inertial system. This split mode allows the navigator to compare the two INS positions and detect any gross inaccuracies induced by Doppler system errors or Omega anomalies. The navigator may elect to operate one or both inertials, aided by Doppler only, Omega only, or unaided. System accuracy is less than 1.0 nm with Omega aiding, or inertial only, and less than 1.0 nm per hour with Doppler-inertial.

Other navigation equipment includes dual Tacan/VOR and ADF, radar and, of course, the sextant. The radar, APQ 30X(X), is primarily a weather radar and has limited navigation capability. It does incorporate a beacon function for air refueling rendezvous.

The NCS interfaces directly with the 4Pi computer because position accuracy is essential. All ground references, i.e., borders, restricted areas, ADIZs, airfields, etc., generated on the data display consoles are referenced to the position supplied by the NCS. Additionally, INS gyros provide stability for the mission radar antenna in the rotodome.

The aircraft autopilot and flight director also interface directly with the NCS. Flight plans can be programmed by the navigator and automatically flown by the autopilot using waypoint steering. The NCS can also be programmed to automatically fly orbit steering patterns such as racetracks, circles, figure 8s, and line-and-return tracks—whatever the mission requires.

The E-3A carries a 17-man crew. The flight crew of four includes a pilot, copilot, flight engineer, and navigator. The mission crew of 13 contains a mission crew commander, senior director and three weapons directors, surveillance officer and three surveillance technicians, radio operator, communications technician, computer maintenance technician, and radar technician. Additional battle staff members may also be added.

I will briefly describe the crew duties to explain AWACS in-flight operations and coordination. The mission crew commander plans, manages, and coordinates the activities of the mission crew. The weapons controllers, under the direction of the senior director, guide fighter aircraft in a variety of tactical missions, including attack against enemy targets. The surveillance officer coordinates the activities of the three surveillance technicians who detect and identify potential enemy aircraft. The radio operator and the communications technician program, maintain, and manage the aircraft internal and external communications equipment. The computer maintenance technician programs, maintains, and monitors the 4Pi computer. The radar technician operates and maintains the system's highly complex radar. All maintenance technicians, when possible, correct malfunctions during flight.

Pilot, copilot and flight engineer duties are basically the same as on other Air Force aircraft. The pilot and copilot are responsible for aircraft operation and safety and must be skilled in aerial refueling required for long flights and extended orbits. The flight engineer preflights all aircraft systems, monitors them during flight, and manages fuel consumption.

The primary duty of the navigator is to insure the positional accuracy of the NCS. On the ground he plans and coordinates route requirements with the mission crew commander, prepares the flight plan/waypoint list for programming the NCS, and initializes the system during aircraft preflight. Once in the air, he selects the NCS operating mode and monitors and updates the system position.

Flexibility, a key ingredient in AWACS operations, is especially important to the navigator. Responding to fluid tactical situations he must quickly replan routes, change orbits, and reprogram the navigation computer.

The navigator also plays a key role in aerial refueling. He directs the refueling rendezvous, an especially challenging task on the E-3A since the mapping radar scope can display relative bearing only, without offset cursor or heading marker. Determining slant range and offset is difficult, and alternate means are often necessary to complete the rendezvous.

Command and control are the core elements of directing tactical air power. Positive control by the combat commander is required to capitalize on the speed and mobility of tactical aircraft and focus their fire power on perishable targets. AWACS does this and, in addition, fills the gaps ground radars leave in our air defense rendering us vulnerable to attack by low altitude bombers

and stand-off missiles. AWACS also provides surveillance over large areas beyond friendly borders, and interfaces with other tactical and strategic weapons systems, significantly enhancing the total offensive and defensive posture of the United States.

Interoperability is another fundamental concept in AWACS operations. One E-3A aircraft can operate alone, provide surveillance over a large area, and direct air and surface forces against a variety of aggressors. However, AWACS realizes its true potential when several E-3As operate together, creating a synergistic effect. Each aircraft enhances the capabilities of the other by forming a network, a defensive umbrella extending beyond national boundaries. The same "enhancement" effect occurs when AWACS interfaces with other weapons systems, allowing concentrated offensive power where and when needed.

The navigator plays a major role in this employment. Mobility, a key concept in the AWACS operation, requires the navigator's precise, long range navigation skills to plan, deploy, and employ the E-3A. AWACS is a jet transport aircraft with aerial refueling capability, and trained navigators must provide highly accurate navigation to allow the aircraft to deploy worldwide and sustain operations indefinitely.

Orbit operations present a unique challenge to the AWACS navigator. Unlike point-to-point navigation where canned flight plans and standard routes are used, the AWACS navigator must be flexible and respond immediately to the ebb and flow of the tactical situation. Replanning orbit locations and patterns in flight, or making in-flight diversions to a new orbit area, is the rule-not the exception.

Finally, the navigator contributes to the E-3A's survivability because survivability is a by-product of detecting, then intercepting or maneuvering away from AWACS attackers. Orbit and route selection must consider terrain, intelligence data, system capabilities, and the availability and location of both friendly and enemy aircraft. Therefore, aboard the E-3A the navigator functions as mission planner and advisor as well as performing traditional navigational duties.

AWACS offers the navigator a chance to use state-of-the-art technology, and join a 17-man crew of experts who have a complex mission, a mission that spans the spectrum of modern conflict. AWACS is happening now, offering the navigator challenges and opportunities—AWACS is where the action is!

Major Schumack graduated from St Norbert College in Wisconsin and obtained his master's degree from Troy State University, Alabama. A distinguished OTS graduate, he received his navigator wings in 1965. Major Schumack served as OIC, Sensor Programs, on the AC-130H Instructional Systems Development Team, and is currently Chief of Navigator Training, 966 AWAC Tng Sq, Tinker AFB.

RADAR TRAIL

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The radar trail procedure evolved from two specific needs of operations personnel. First, a technique was required for multiple aircraft departures under adverse weather conditions with safe separation and formation integrity. Second, strategists desired a means of all weather station keeping that would insure the separation of aircraft, while exploiting the advantages of mass.

The Southeast Asia war generated other application of radar trail. The "Pathfinder" techniques employed an aircraft with highly sophisticated navigational/bombing equipment as a bombing offset for other aircraft in precise radar trail. At the same time, radar trail proved a viable alternative to visual formation when penetrating the heavy weather of that tropical theater.

These radar trail applications require at least a working knowledge of the associated techniques. To describe those techniques and their various applications, I have divided the subject into six topics. The first four are somewhat chronological and consist of: planning, briefing, take-off, and departure. The other two topics are radar techniques and crew coordination.

PLANNING

Weather

Planning, as the much abused phrase goes, is a prerequisite to prevent substandard performance. As one of the key preflight items, the anticipated weather conditions must be considered. What is the expected ceiling? Are the clouds layered? What are the cloud tops? What is the expected in-flight visibility? Is heavy weather forecast? These are just a few of the weather considerations that must be made prior to conducting radar trail operations. Due to considerable impact, the crew must plan adequately for any weather conditions.

The Profile

Another significant planning factor is the flight profile. The more complicated your radar trail work, the greater the chance for a foul up. Standard Instrument Departures (SIDs) provide an excellent preplanned source of departure profiles. The primary advantage of SIDs is that all flight members have an alternative method for navigating the prescribed ground track in the event radar contact is lost.

Altitude Selection

Altitude selection is another integral part of the radar trail profile. MEAs, cloud conditions, departure restrictions, and aircraft performance must be considered. In addition, the need for altitude separations must be anticipated in the event that radar contact is lost during the departure.

Spacing

Aircraft spacing also must be considered during the planning phase. While half mile trail has the advantage of expediting a visual rejoin once VFR conditions have been encountered, it also has the disadvantage of not providing the trail aircraft with much advance notice of turns. Experience has shown that three mile trail is quite practical for tactical aircraft both during departure and

enroute maneuvering. The spacing selected must be based upon aircraft maneuverability, avionics capability and the purpose of the formation (i.e., tight formations for troop/supply drops or a looser formation for weather penetrations).

BRIEFING

Next to planning, the briefing phase is probably the most important. During this phase, the flight lead must insure that each and every flight member understands both the requirements and the method of executing the maneuvers. The following topics must be fully covered: weather, take-off spacing, departure profile, airspeeds, altitudes, turn points, radio procedures, and back-up procedures in case of lost radar contact. Much of this information is contained in the applicable 55- series manual for your aircraft. Adherence to as many of the standard procedures as possible reduces both confusion and the time requirements for briefings. However, it must be understood that the briefing is complete only when each and every member of the formation knows precisely what is required of him.

TAKEOFF

In spite of the complexity and sense of urgency generated by radar trail departures, the takeoff role is no time to have your nose pressed against the radar scope. Full attention must be devoted to aircraft performance due to the time/event compression during takeoff. Anything but complete and continuous takeoff monitoring could negatively impact the timely execution of emergency procedure.

As an alternative to radar work on the roll, I would suggest configuring your equipment prior to taking the active.

1. Select the air-to-air mode.
2. Preset tilt for the preceding aircraft's expected relative geometry.
3. Select a scope range compatible with acquisition of the entire flight. (Omission of this critical step may result in "blue" three and four trying to occupy the same airspace behind two.)
4. Anticipate where the preceding aircraft will be found on the scope.
5. Finally, of foremost importance, verify the operation of the radar and tune for the optimum air-to-air presentation.

DEPARTURE

The radar trail departure includes all of the elements required of other trail applications. Therefore, my discussion of in-flight techniques will concentrate on departures.

Altitude Calls

During departure all aircraft should announce passing through specified altitudes. The calls continue until the entire formation is tied-on. This procedure assists in maintaining altitude separation when lateral separation is unknown. (These calls are generally made in 5,000 foot increments.)

Lead's Tasks

A good formation begins with the lead aircraft. It is absolutely mandatory for lead to adhere as closely as possible to the prescribed headings, altitudes and airspeeds. Since radar trail procedures are often associated with weather conditions, lead generally will adhere to instrument flight parameters such as 30° of bank. Should circumstances prevent total adherence, deviations must be immediately communicated to other flight members.

In some instances, prebriefing is not possible. Under these circumstances, the flight lead takes on additional airborne responsibilities. These include communicating:

1. Airspeed to be used, including subsequent changes.
2. Altitude to be maintained, announcing any changes and calling when level.
3. Turns initiated, to include roll out heading.
4. Passing altitudes until the trail aircraft have called "tied-on."

The flight lead must also anticipate the possible requirement for altitude separation should radar contact be lost.

The Wingmen

One of the primary functions of trail aircraft is to keep the lead informed of their status, (i.e., tied-on, no-joy or lost contact). A second, but no less important task for the trail aircraft, is attaining and/or maintaining position.

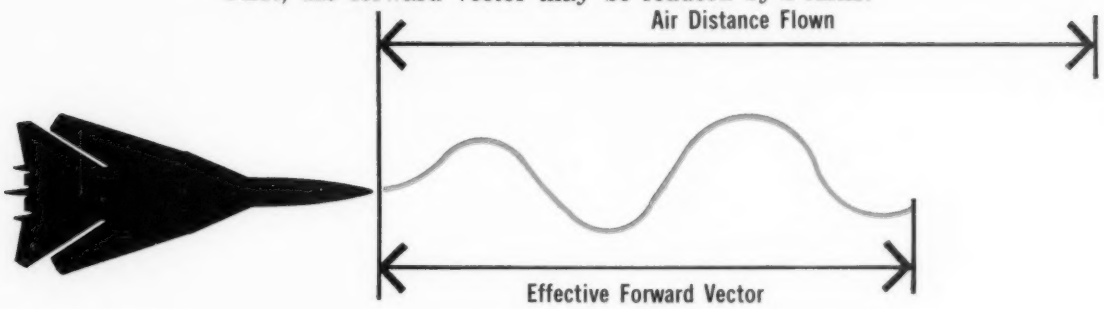
Straight Line Spacing

Relative fore/aft positions in straight line flight are generally adjusted by airspeed changes. This

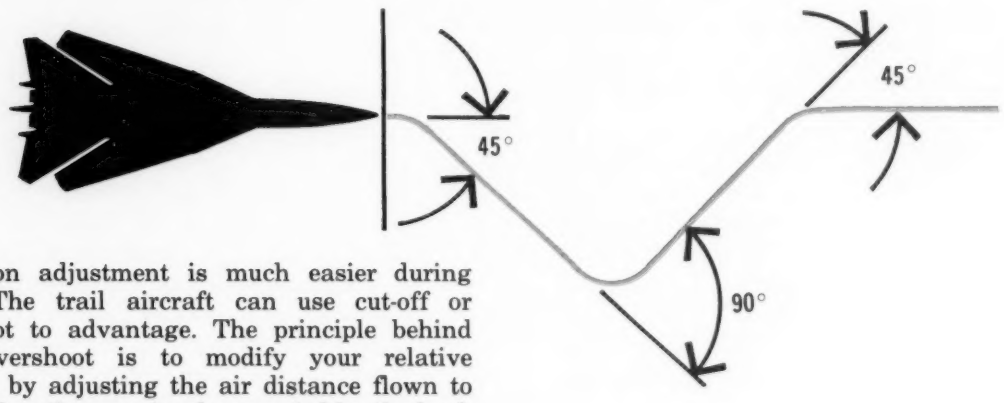
method is so patently obvious that it doesn't deserve elaboration. There are, however, some alternative methods for adjusting straight line cruise spacing.

Spacing in Turn

First, the forward vector may be reduced by S-turns.



A second method of reducing forward progress is the double-drift. This technique consists of a 45° turn, followed by a 90° reversal and then a 45° turn to the original heading. (Just another application of an old nav technique.)



Position adjustment is much easier during turns. The trail aircraft can use cut-off or overshoot to advantage. The principle behind cutoff/overshoot is to modify your relative position by adjusting the air distance flown to reach a location previously occupied by the lead. The techniques involved are best explained by diagram.

Bank Angle Method

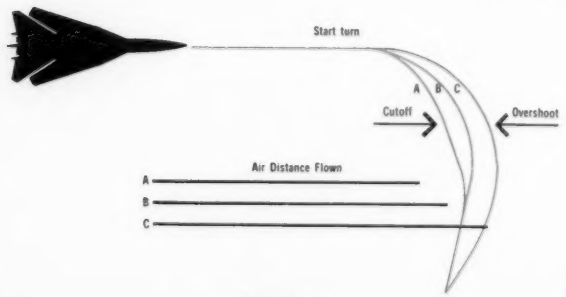


Diagram 1

A - Bank angle greater than lead will result in closure as a result of the shorter air distance flown.
B - Using lead's bank angle will maintain current spacing.
C - Using less bank angle than lead will increase spacing as a result of the greater air distance flown.

Turnpoint Adjustment Method

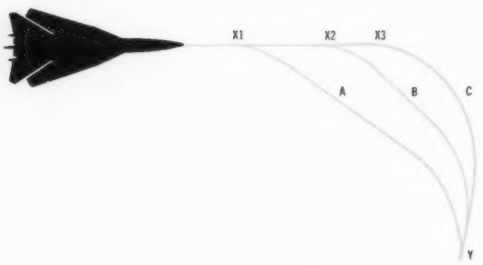


Diagram 2

A - Turning prior to lead's turn point (X1) results in closure as a result of the shorter air distance flown.
B - Turning at the same point as lead (X2) maintains spacing.
C - Turning past lead's turn point (X3) increases spacing as a result of the greater air distance flown.

It should appear obvious that a combination of these techniques will be additive or compensating.

RADAR TECHNIQUES

Since none of us is blessed with a "bird's eye view" of the radar trail formation, we must rely upon a manmade substitute. For our purposes, the previously mentioned techniques require the use of a radar scope.

Maintaining trail position during straight line flight consists of simply keeping lead centered on the scope. This can be made easier by comparing your heading with lead's. Maneuvering flight is somewhat more involved.

Air-to-Air Radar Scope Interpretation (RSI)

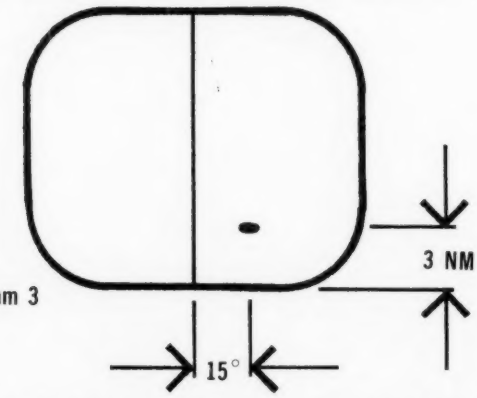


Diagram 3

If lead uses 30° bank turns, you will find that letting lead drift 5° on the radar scope per mile in trail before starting your turn will result in coincident turn points. (The situation is portrayed as it would look on a B sweep radar scope in Diagram 3. The same procedures would apply regardless of the type of scope presentation.)

Once into the turn, matching lead's bank angle will keep lead at the proper offset angle and range. Your relative position will remain stabilized. To use cutoff or overshoot requires only slight modifications.

Cutoff

To apply cutoff, the trail aircraft must reduce lead's drift angle either by turning early (Aircraft A in Diagram 2) or by using a greater bank angle than lead once the turn is started (Aircraft A in Diagram 1). Diagram 4 shows how the use of cutoff would appear on a "B" scan radar scope.

CUTOFF

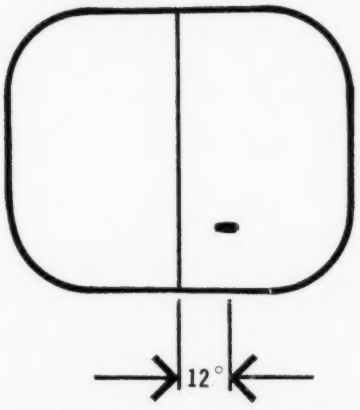


Diagram 4

Trail aircraft starts his turn when lead is 12° offset rather than 15° offset

OR

Trail aircraft uses greater bank than lead when lead is 15° offset. As a result, lead will drift toward the nose. When the desired

reduced offset is achieved, the trail aircraft will adjust bank angle to maintain the desired relative offset.

Overshoot

To use overshoot the trail aircraft must increase lead's drift angle. This may be done by either turning late (Aircraft C in Diagram 2) or by using less bank angle than lead (Aircraft C in Diagram 1). This situation is portrayed as it would look on a radar scope in Diagram 5.

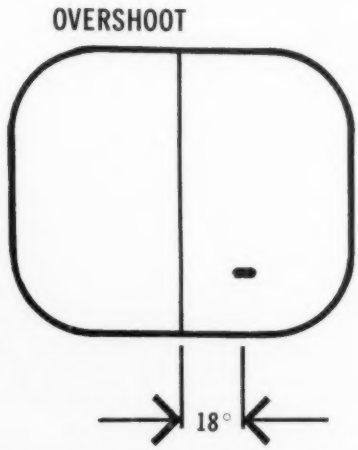


Diagram 5

Trail aircraft starts his turn when lead is 18° offset rather than 15° offset

OR

Trail aircraft uses less bank than lead until the desired drift angle is achieved. The trail aircraft will then adjust bank angle to keep lead offset the desired amount.

To maintain position, once it is established in a turn, you must increase bank angle if lead starts to drift away from the extended centerline and reduce bank angle as lead drifts toward the extended centerline. To maintain the proper spacing on the radar scope, range may be increased by reducing bank angle or range may be reduced by increasing bank angle.

Rollout

As lead reaches his rollout heading, he will begin to drift toward the nose. Let the lead drift until he is on the nose at the desired range when the trail aircraft reaches the rollout heading. It should be noted that radar trail, like all other formations, is not a static condition but a series of continuing corrections. As your skill level increases the magnitude of those corrections will decrease.

CREW COORDINATION

One of the most significant issues in radar trail work is crew coordination. It does little good for a WSO to be fully versed in trail techniques if he can't effectively communicate the required actions to the AC. Similarly, an AC who can't translate well-communicated requests into action negates the efforts of even the most skilled WSO.

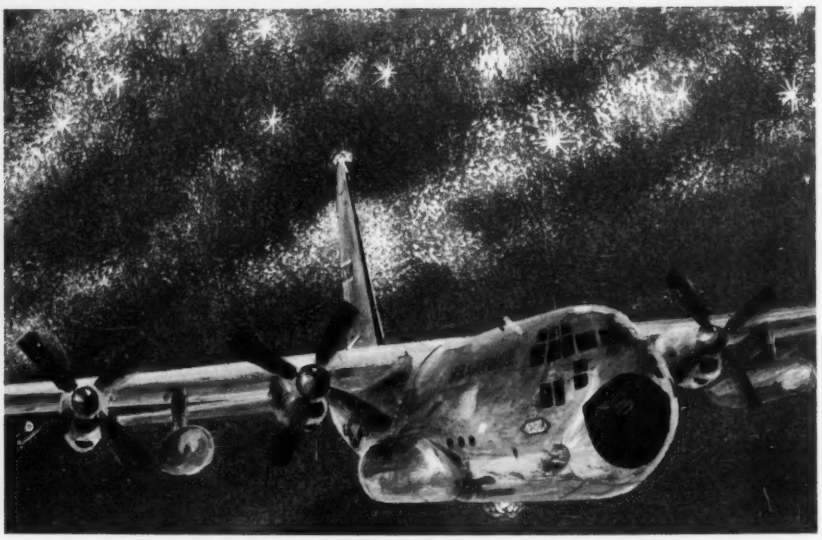
To promote efficient communication between AC and WSO, the Air Force has developed the abbreviated commentary for air-to-air operations. The commentary takes two forms, descriptive and directive. The purpose of each is self-evident. The standard terms are listed in Joint Manual 55-200.

SUMMARY

Just as an exacting performance by a professional athlete belies the complexity of the task, the apparent simplicity of radar trail disguises the intricacies of the maneuver. To carry the analogy one step further, the aircrew, like the athlete, finds that perfomance is a direct result of preparation and training.

Once the various preparatory tasks involved in radar trail are mastered, the execution becomes almost second nature. However, to attempt trail maneuvers without being fully versed in its intricacies invites both confusion and/or catastrophe.

Captain Voellger graduated from UNT in 1969 and then completed F-4 training at MacDill AFB. Following a USAF tour at RAF Bentwaters, England, he attended UPT at Laredo AFB. Next came assignments to the F-111A at Nellis AFB and Takhli RTAFB, Thailand. Captain Voellger presently serves as an F-111D Aircraft Commander at Cannon AFB.



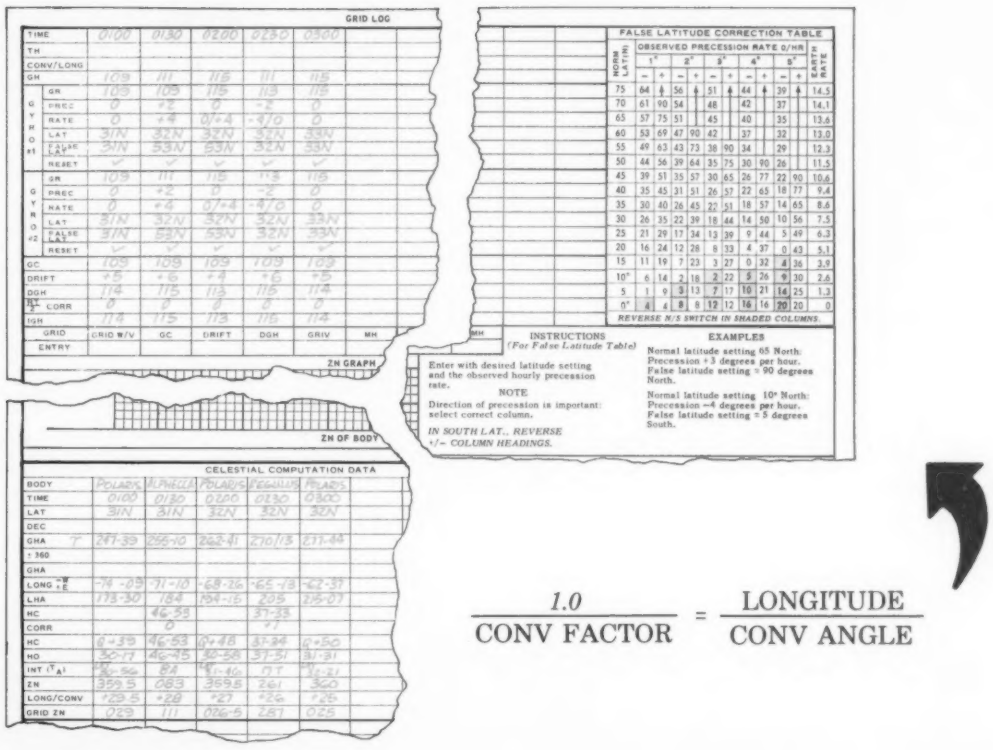
CELESTIAL TECHNIQUES

Captain Jay A. WEISS
32 TAS/DOV
Little Rock AFB, AR

Neither night celestial nor grid navigation need be as difficult as we navigators tend to make them. The goals are simple: obtain reliable lines of position and heading information. In practice, however, we tend to obscure the goals with so many computations that the mathematics become an end rather than a means.

I will discuss some techniques that simplify both night celestial and grid by reducing computations to more managable levels, while retaining reliable heading and position information. The usual advice applies about using available aids, plotting accurate dead reckoning position, and computing precise wind, but for brevity's sake, I have concentrated on specific techniques. My methods refer to C-130 aircraft and procedures, but much of the information can be useful in other aircraft and commands. All sample computations are on the MAC Form 25, Flight Plan and Record. The LOPs were plotted on a GNC 9N chart, edition 9. I used a groundspeed of 300 knots and a true track of 080°.

I often use a night celestial technique which is much easier than a three star fix, is accurate and works especially well on north/south or east/west headings. Using Polaris and one other body, assume an initial Polaris at 0100Z, plot the LOP and then advance it 30 minutes. Remember to adjust the LOP for coriolis effect. At 0130, shoot one of seven stars available in HO 249, Vol I, and pick a body which will give a good speed line. Since the true track is 080°, choose a body with an azimuth close to 080° or 260°. Then plot the LOP shot at 0130 and you will have a 2 LOP fix. Next, advance the 0130 LOP to 0200 and shoot Polaris again at 0200. In short, you will obtain a two LOP celestial fix every half hour, with no LOP over 30 minutes old at any fix. This method is especially useful when pressed for time or when one or more sophisticated aids malfunction because it saves time computing, shooting, and plotting two



$$\frac{1.0}{\text{CONV FACTOR}} = \frac{\text{LONGITUDE}}{\text{CONV ANGLE}}$$

additional bodies in a three star fix. I also simplify computations further by listing, early in the mission, the GHA of Aries for each even hour and half hour.

Note that I advocate shooting on time. If you miss a shot, simply move the assumed position (or LOP) 15 minutes of latitude east or west for each minute of time the shot was early or late. Then advance or retard the LOP (or assumed position) with the best known groundspeed. If the fix is to be plotted by the fix time, advance each LOP a few more minutes, or advance the entire fix downtrack. This procedure gives the same adjustments for motion of body and observer that we obtain with mathematical computations.

A similar method simplifies night grid navigation. Work the precomputation down to an LHA of Aries, enter HO 249 and pick one of seven bodies available. Compute and put grid Zn in sextant azimuth counter, shoot on time, and record grid heading. You can combine a grid heading shot with an LOP by having another crew member read the compasses at mid time of the shot, thereby adding a heading check to the night celestial method mentioned earlier.

I use false latitude tables to correct for precession, and reset the gyros each time I take a heading shot. This eliminates the need to compute total and expected precession, and reduces the aircraft heading problem to grid course plus or minus drift.

One additional technique is to use a rising or setting body for heading checks and a body near meridian passage for LOPs (Polaris is the exception). The reason is that azimuth changes slowly on a rising or setting body, while altitude changes slowly on a body near meridian passage. If the body's LHA is near 270° or 090°, it is rising or setting. If the body's LHA is near 180° or 360°, it is close to meridian passage.

In closing, let me stress once again that these procedures are designed to simplify grid and night celestial. If your command directives permit and you choose to try my methods, I think you will find that both night celestial and grid can be easier than most of us remember.

A graduate of the University of Kansas, Captain Weiss completed navigator training in 1968 and spent the next two years in Southeast Asia. He has flown in the C-130 and has logged 5,000 hours as a military navigator plus 2,000 hours as a civilian pilot. Captain Weiss is assigned to the 32 TAS, Little Rock AFB, as Chief, Squadron Navigation Evaluation Section.

Rendezvous in the "Q"

Captain David E. BROWN
349 ARS
Beale AFB, CA

Thousands of Air Force navigators have flown in the KC-135A Stratotanker and are well acquainted with rendezvous procedures for the B-52 and the numerous other aircraft equipped for aerial refueling. Reaching the air refueling control point (ARCP) a minimum of fifteen minutes prior to the air refueling control time (ARCT), the tanker navigator maintains his orbit (*upstream* of the ARCP) until given the 70 nm call by the receiver. Upon receipt of this range call, the tanker turns toward the receiver and subsequently makes his final turn to roll out in front of the receiver in accordance with the established turn range/offset chart. All tanker navigators, as well as all receiver pilot/navigators, are well acquainted with these normal point parallel rendezvous procedures.

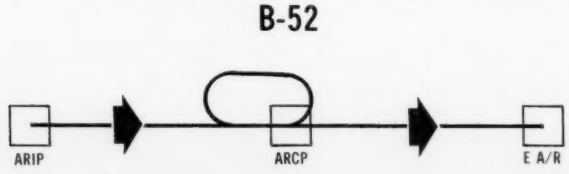
At Beale AFB, however, the crews of the 100th Air Refueling Wing use a more precise and demanding point parallel rendezvous for a most precise and demanding receiver, the trisonic SR-71. An SR-71 rendezvous differs significantly from the "conventional" rendezvous, and its success depends almost solely on the navigator and his equipment.

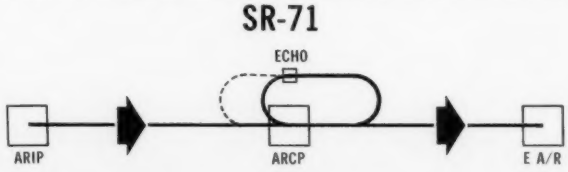
First, let's discuss the "Q" model tanker. From all outward appearances, it is almost impossible to distinguish a "Q" model from an "A" frame. But closer inspection reveals visibility enhancing strobe lights on the "Q's" wing tips, fuselage, and tail cone. Upon entering the right wheel well, you will notice the usual single point refueling receptacle (SPR), as well as the placard warning of JP-7 refueling only. This SPR feeds the forward body, aft body and upper deck tanks only, which are the refueling tanks, and JP-7 is the special fuel used by the SR-71/YF-12 series of aircraft. Another SPR in the left wheel well supplies the remaining tanks with the conventional JP-4 fuel.

Entering the cockpit, tanker navigators will see the usual -135 navigational equipment, i.e., the N-1 compass, APN-59 search radar, ASN-7 navigation computer, APN-81 Doppler radar, SCR-718 radar altimeter, and the IFF/SIF. However, several additional systems will almost immediately be noticed, and probably the most visible addition is the APN-70 Loran A receiver. Loran A may be old, but it provides the "Q" model navigator with an additional overwater fixing aid not found on the "A" frame. More importantly, the Loran system provides the only precise way to maintain an orbit at those ARCPs beyond usable radar or Tacan range. It is a welcome addition.

Looking further, an "A" frame navigator will spot the third UHF radio (appropriately called the Comm 3, used almost exclusively by the navigator), and an additional Tacan. This Tacan set is completely independent of the pilot's Tacan, and reads out only at the navigator station's BDHI. It, too, is a welcome addition to the navigator's repertoire because of its longer range capability. However, use is restricted almost solely to the rendezvous, and then only in the air-to-air mode, where the Tacan provides DME and bearing information between the tanker and receiver. The dash one states that the navigator's Tacan set must be off during penetrations and anytime the pilot's ARN-72 Tacan is being used for aircraft positioning as the two systems will interfere with each other due to antenna placement on the fuselage.

The Comm 3 radio is the heart of the KC-135/SR-71 rendezvous for this system. In addition to being a standard UHF radio, it provides ranging (DME) information between the tanker and the receiver. This ranging information is critical, as it (or DME from the Tacan) is the primary piece of information used by the tanker navigator in effecting a successful rendezvous. After reaching the ARCP a minimum of 30 minutes prior to the ARCT, the tanker orbits *downstream* of the ARCP so as to be exactly over the ARCP at ARCT minus 12 minutes. At this time, the navigator starts his final orbit and proceeds downstream for a prescribed amount of time (based on the receiver's DME from the tanker when the tanker is at the ARCP), and then turns back toward the receiver. Passing Point Echo, a point approximately 9 nm abeam the ARCP in the orbit (see accompanying diagram), the navigator starts his stop watch and carefully monitors the steadily decreasing DME. At approximately 25 DME (based on drift conditions), the nav starts his final turn so as to roll out ahead of the receiver at 4½ DME. The stop watch provides the nav with an accurate backup method should DME break lock or otherwise be unavailable during this portion of the rendezvous, because precise final times to run towards the receiver have been established based on the receiver's DME when the tanker is at Point Echo.





At 3 DME, the nav calls "descend and accelerate" and the tanker is descended 1,000 feet to the refueling altitude, and accelerated from the 275 KIAS orbit speed to 320 KIAS. After boom contact is established, the tanker accelerates further to 355 KIAS which is maintained through the end air refueling point.

The entire rendezvous normally is conducted without verbal communications between the tanker and receiver crews until boom contact is made. The SR-71 moves from the air refueling initial point (ARIP) to the ARCP and the tanker orbits so as to roll out ahead of the receiver at 4½ DME using the Comm 3 or Tacan ranging information. Established timing charts assist the tanker navigator in determining his orbit timing requirements for either a subsonic (cold) rendezvous, or a supersonic (hot) rendezvous, based on either the receiver's DME (from the tanker), or the receiver's distance to go (DTG) to the ARCP. The orbit must be precise, with exact placement over the ARCP, since the tanker must be "right on" to facilitate the rendezvous. Orbiting in areas where high cross winds exist poses a special challenge because of the necessity to roll out over the ARCP. Several techniques have been devised to assist the "Q" model nav under such conditions. One choice is an offset orbit, where the orbit is maintained at an artificial ARCP some distance into the wind and allow the wind to then blow you into the actual ARCP during the final orbit. The most common technique, however, is to move Point Echo into the wind (the distance into the wind is determined by the drift encountered), and again allow the wind to blow you into the ARCP. DME to DTG conversion charts are available for those air refueling tracks where the receiver approaches the ARCP in a large arc-shaped track. In these cases, the DME readout does not accurately represent the distance the receiver has to go to the ARCP. Hence the necessity for these conversion charts, otherwise the timing charts would be inaccurate. An alternate rendezvous procedure is available for use when ranging information is not available. The tanker navigator, while passing over the ARCP, queries the receiver for his DTG. From this data, the tanker nav can determine his orbit requirements. When passing Point Echo in final orbit, the nav again requests the receiver's DTG, and uses this final DTG figure to compute his precise final time to run toward the receiver. At the expiration of this time, the tanker then makes the final turn so as to roll out ahead of the receiver at 4½ DME.

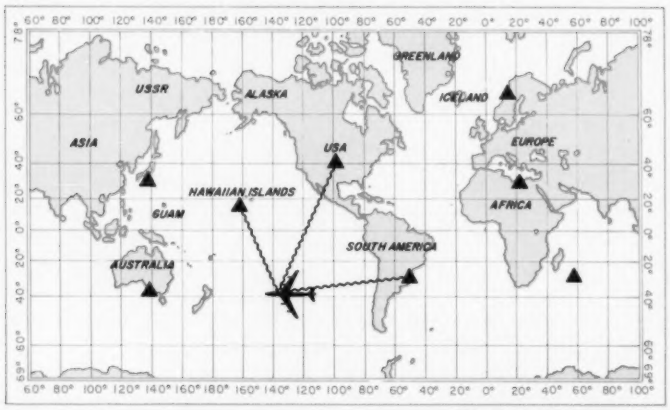
As the SR-71 closes to the precontact and contact positions, two additional pieces of equipment facilitate the refueling. One is the boom spotlight, which aids the boom operator in finding the "Blackbird" and its refueling receptacle during night refueling operations. The second piece of equipment is the boom interphone system, which enables the two crews to communicate directly over a common interphone system once boom contact has been established. Both systems have proven valuable on numerous occasions.

Experience at Beale has shown that a tanker navigator needs approximately six rendezvous to become proficient. The "Q" model navigator is entirely responsible for the rendezvous as he controls the crew's actions and directs the sequence of events. He has to determine those orbit headings which will effectively kill the drift, compute the exact orbit times, and accurately use the appropriate timing charts. The nav is extremely busy during the rendezvous. With an average closure rate of over 13 nm per minute during a hot rendezvous, there is no room for error. An overrun will often cause an aborted mission, especially if the two aircraft cannot get together, while rolling out too far ahead wastes valuable time as the aircraft maneuver to close the gap and complete the refueling. A well executed rendezvous facilitates the refueling process which must be completed on schedule so that the receiver can meet his mission timing requirements.

This rendezvous is definitely a challenge and allows the KC-135Q navigator ample opportunity to demonstrate his navigational talents and leadership skills. The responsibility and pressure for a successful rendezvous rest solely on the navigator's shoulders. There is absolutely no doubt in my mind that the KC-135Q nav is one of the best, if not the best, navigator jobs in the Air Force today. And there's one final plus if you like to travel. Beale's tanker crews pull approximately 100 days TDY per year. Interested? Fill out your Form 90, and join the Beale crews who "do it in the Q."

Following Aircraft Maintenance Officer School, from 1969 to 1974 Captain Brown served in KC-135 and F-4 aircraft at Richenbacker AFB, McConnell AFB, and Kadena AB. After navigator graduation in 1975, Captain Brown completed combat crew training. He has been assigned as a combat crew member, 349 ARS, Beale AFB, since that time.

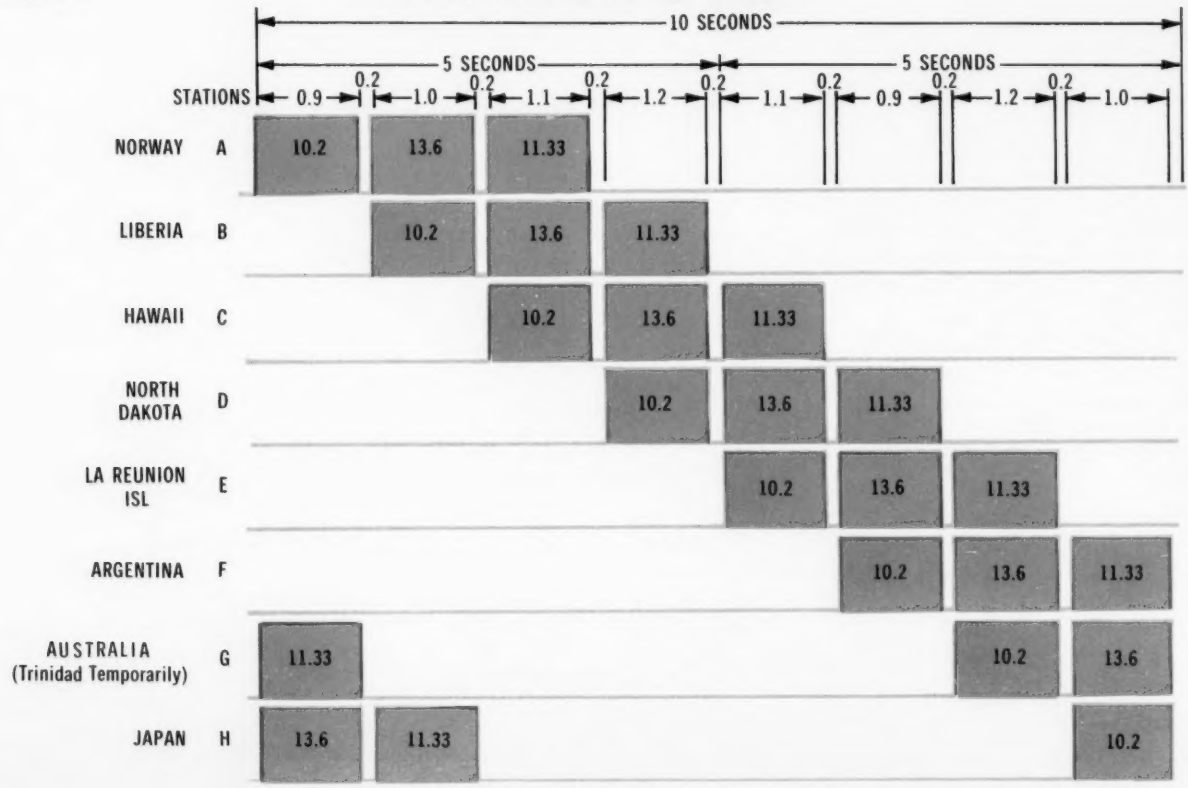
Figure 1 **OMEGA TRANSMITTER LOCATIONS FOR WORLDWIDE NAVIGATION**



Lt Col L. D. MORMINO
HQ MAC/XPQ
Scott AFB, IL

The frustrations of the aircrew navigator attempting to extract an accurate position from Loran A, while flying in the "soup" over the south Atlantic, are well known. The cause for this dilemma is the lack of a worldwide Loran A signal coverage and the high degree of skill required to "pull the fix out of the grass" on the Loran's CRT. Thanks in part to the JCS decision to terminate the military requirement for Loran A by Dec 77 and the Omega 2041 program, the C-130 navigators will no longer have this problem. The Omega navigation ground station network is currently providing near worldwide coverage. Seven of the eight permanent Omega ground stations are operational. The eighth station will be located in Australia and will be operational 18 months after site selection (see Figure 1). The aircraft receivers were developed and procured under the Omega 2041 program. These receivers (AN/ARN-131) will be installed in nearly all Air

Figure 2 **OMEGA TRANSMISSION FORMAT**

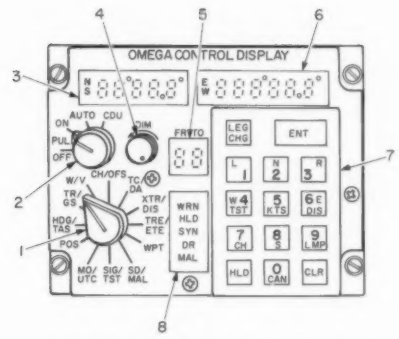


Force C-130s (May 77-Oct 78) and will provide a position with an accuracy of plus or minus two nautical miles—automatically!

Of the eight planned ground stations, only two (Hawaii and North Dakota) will be U. S. owned and operated; the remaining stations will be operated by the host nation. These stations transmit at much lower frequency (10-13 Khz) than Loran and, therefore, have a much longer range. Unlike Loran, Omega operates with signal phase differences rather than time of arrival. Since there is only one Omega "Chain," all stations must transmit on a time-sharing basis. As shown in Figure 2, Station A (Norway) begins its transmission format on 10.2 Khz for .9 seconds, then is silent for .2 seconds, comes back on the air on 13.6 Khz for 1 second, again is silent for .2 seconds, then transmits on the final frequency (11.33 Khz) and then is silent for 6.6 seconds. The other stations sequence through their transmissions in a similar manner. With this format, position information is updated every 10 seconds. This transmission sequence, with the three frequencies, was carefully developed to avoid ambiguous positions. As previously mentioned, Omega uses phase differences rather than the more familiar Loran time differences. Since the same phase differences between two stations reoccur at every half wavelength, numerous LOPs will be defined. By using all three frequencies, the same phase difference (LOP) will reoccur only every 72 nautical miles. Therefore, if the navigator can determine his position to within 35 nautical miles, the Omega equipment will refine it to within 2 nautical miles and keep it there. The signals are affected by the same type transmission anomalies as Loran because the signals are contained between the ionosphere and the surface of the earth. Therefore, sudden inosphere disturbance (SID), polar cap absorption and diurnal shift can cause positional errors. However, SIDs are not common and the other error sources can be compensated for so that the position error should not exceed 5 nautical miles 95% of the time.

The AN/ARN-131 airborne Omega receiver is a computerized automatic navigation system. It consists of a control display unit (CDU, Figure 3), receiver-processor and antenna. In the C-130 the CDU is located at the navigator's station and allows full operation of the set. The receiver-processor, the heart of the system, is located under the flight deck in the avionics compartment. The H-field type antenna is not as susceptible to precipitation static as the old long wire Loran antenna. The Omega antenna looks like a black box (approximately 1′ x 1′ x 3″) on the underside of the aircraft's tail. To operate the AN/ARN-131 the navigator needs only to: (1) turn on the set and, (2) insert month, time of day, and approximate position. The "131" will then automatically select the best three situations available, synchronize to the signals, and resolve the aircraft position. The computer automatically applies corrections for known signal propagation errors and takes the LOPs with the best "cuts." In addition, the computer will accept nine waypoints (checkpoints) for enroute navigation and compute winds, desired headings, distances, and times (ETE/ETA) between waypoints. In short, it will compute everything the navigator needs for overwater or overland navigation. As a word of caution, Omega is not a panacea for all navigational problems. As in the past, cross checks are necessary as well as celestial, radar, Doppler, map-reading and judgment. Omega is only an aid to navigation—the navigator is still necessary.

Figure 3



CDU Controls and Indicators

1. FUNCTION SELECTOR SWITCH
2. MODE SELECTOR SWITCH
3. LEFT NUMERIC DISPLAY
4. DIM CONTROL
5. FR TO DISPLAY
6. RIGHT NUMERIC DISPLAY
7. DATA ENTRY KEYBOARD
8. SYSTEM STATUS DISPLAY

Major Mormino graduated from Bradley University ROTC in 1961 and completed UNT in 1962. Following NBT in 1963, he was assigned to C-130s at Langley AFB. After four years in the C-130, Major Mormino was reassigned to Mather AFB as a UNT instructor. He now serves as an Avionics Systems Program Manager, HQ MAC, Scott AFB.

Weapon Systems Officer Management,

My End of Tour Report

Major Nolan W. SCHMIDT
AC&GSC—Sec 21
Ft Leavenworth, KS

Many of you reading these words, particularly you Weapons System Officers, will associate my name with actions that affected your career management. For the four-plus years prior to my current assignment, I served in both Career Development and Fighter Resource Management at the Military Personnel Center. During that tour, many folks visited or called to discuss career development and rated assignment policies. Often the caller would begin with: (1) "Hi, what good deals you got going for WSOs these days?" (2) "You personnel folks just put me on assignment to East Nowhere and I want to know why." (3) "Say, what is the big picture on the WSO force, anyway?" (4) "How can I get into the supplement?" (5) How can I get out of the supplement?" or (6) "How do I get your job?"

A lot of misinformation, rumors, and misconceptions about the future of the WSO force made the rounds. My purpose in writing this article is to provide you with information on what has happened in WSO management, provide answers to the most often asked questions, let you in on what the future looks like, and also suggest what you might do to favorably influence your own career prospects. While this discussion applies primarily to the fightergator, many of you from other weapons systems will find information that may be useful in planning your career.

Adjustments in undergraduate nav production, gate legislation, supplement authorizations, etc., have significantly modified the "rules of thumb" for career progression. Opportunities are still there. They are there in numbers as large or larger than before; however, you have to understand the constraints and opportunities that you face. Hopefully, this article will help you realistically appraise your chances of meeting your goals and achieving your career aspirations.

During my four years at the Center, I witnessed tremendous changes in the composition and distribution of the WSO force. The Southeast Asian withdrawl, RF-4 reductions, USAFE F-4 redistribution, crew ratio changes, elimination of operational F-101s, and the elimination of nav billets in OV-10 and B-57s have all contributed to the turbulence experienced by members of the WSO world. There will be more turbulence in the future as the F-111 redistribution is completed, some F-4 units convert to single-seat fighters as part of the Tactical Air Force (TAF) conversion, and the F-4G and EF-111 come into the inventory. The conversion to F-15 aircraft and the planned purchase of F-16s are currently the most visible factors that concern WSOs and have been viewed by many WSOs as a portent to the end of a career field—the dissolution of a career avenue. Not so!

The TAF consists of 26 Tactical Fighter Wings. If you were to inventory today's fighter force, add the scheduled purchases of the F-15, F-16, and A-10 aircraft, and subtract the A-7s that are on their way to the ANG, you would find that two-seat fighters are going to be around for a long time. Figure 1 depicts the total WSO/EWO fighter requirements through the next five years. The five-year figure was selected because defense requirements are geared around the Five Year Defense Program (FYDP). These requirements extend throughout the forseeable future and I'm not even going to address the possibility of two-seat A-10, F-15, or F-16 aircraft. F-111s and RF-4s remain approximately at their present strengths throughout the FYDP and beyond, and the F-105 is scheduled to phase out when the F-4Gs have entered the inventory and the other F-4 requirements decline. Total current TAF WSO/EWO authorizations (including staff) number around 3,000. At the the end of the FYDP,

those authorizations are projected to be around 2,300. Is this the death of a career field?

Another common misconception is that because fighter authorizations are declining, many WSOs will be forced out of fighter systems. Again, not so! When I left the Center the WSO world was still somewhat short of being fully manned. Those shortages were not in the crew force or in the fighter staffs, but in what we call fair-share requirements. Fair-share requirements are positions that can be filled by a rated officer with the proper aeronautical rating, i.e., general ops/staff duty, (base operations officers, command post controllers, 2295 requirements through Headquarters Air Force level), ATC instructor duty, etc. A portion of the shortages is caused by RTU wings being manned at less than full authorizations. As you know, an RTU squadron does not employ a full squadron's complement of WSOs, but only the few required for instructor duty. So, if these wings were converted into combat resources and fully manned, we would withdraw WSOs from fair-share requirements to make up the shortages. Due to changes in training methods, these units are now being manned much closer to their full authorization.

At any rate, current production of WSOs and EWOs for fighter systems is based on a long range goal of matching requirements with the inventory at the end of the FYDP. Production is currently slightly less than attrition and, when matched with declining requirements, allows MPC to match inputs to inventory and requirements at the end of the FYDP. The Air Force will not surge-produce a batch of WSOs who are going to be surplus to fighter requirements a year after they complete RTU.

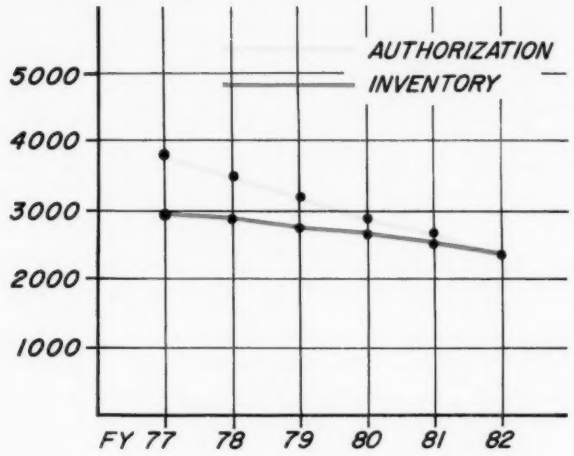
At this point, let's briefly touch on weapons system requirements. The F-4 WSO/EWO resource obviously will be adjusted in the next few years. Some of you currently in F-4s will go to fair-share requirements, supplement, etc. Many will go to other weapons systems such as the RF-4, F-111, EF-111, and F-4G. Limited numbers of F-4 WSOs will attend EWT and go to fighter EW requirements. Many others will go to fighter staff positions and serve in supervisory functions. The President's announced plan to slow F-15 production will keep F-4 authorizations on the books longer than originally planned. I do not foresee significant numbers going to airlift or strategic bomber/tanker requirements. F-4 and F-105 Weasels will, in many cases, move to the F-4G, and many will go to 2275 duties in worldwide TAF staff requirements.

Currently, we have a unique situation involving EWOs—there are more staff than crew requirements. This situation, compounded by the Aviation Career Incentive Act of 1974 (commonly called the "gate legislation") brings about a few problems. First, the services must insure that all rated officers meet gate requirements where possible and accumulate at least 9 years of gate credit. Because of the gate requirement and the disproportionately high number of staff requirements, few EWOs will ever serve in supplement duty. That is not to say that the EWOs will not have broadening opportunities—quite the opposite. The opportunity for the EWO to achieve MAJCOM and Air Staff level positions is greater than that found in almost any other rated AFSC. Being an EWO in fighters is a constraint *only* in that it limits the opportunities to serve in other career fields. From a career progression standpoint, those with the "record" have extraordinary opportunities for exposure at the highest staff levels.

Both the RF-4 and F-111 systems stay with us throughout the FYDP at their current levels and both have a higher than average rank composition. As the F-4 draws down, some of the younger F-4 WSOs will enter the F-111 or RF-4 systems. As they and UNT graduates enter these systems, manning will allow some of the senior WSOs to progress to staff, supervisory, and nonoperations requirements. During the last few years, the F-111 crew force, both pilot and WSO, has had limited progression because of low training rates. These rates were brought on by low initial inputs and aircraft groundings due to maintenance problems. An additional factor was the right seat pilot (PWSO).

Due to problems with pilot absorption out of UPT and the complex nature of the F-111, for a time pilots were trained into the right seat of the F-111. As they ended their "term" in the right seat, they retrained into the left seat. Thus we trained a right-seater who was lost after a couple of years of right seat service. That expended a training slot that a navigator would have occupied and, due to his longer retention, would have increased the total WSO force, thereby allowing other WSOs to move out of crew duty. The PWSO program has ended and this, too, eventually will ease the F-111 aircrew constraints. One point has to be made—many F-111 WSOs are remote eligible. The same crew manning constraint that kept them out of staff and supplement duty also sheltered them from short tour requirements. Before these remote eligibles go to ops/staff, supplement, etc., a remote

PROJECTED WORLDWIDE WSO MANNING
TAC FIGHTER AND TAC RECCE (Includes EWs)



probably will come first and will be spent in operations supplement duty.

You RF-4 WSOs are going to see increased inputs during FY 78 also. Additionally, you will see some RF-4 WSOs return to the force who were released from ops when the RF-4 phased down and several squadrons were inactivated. Gate will be the reason many return; weapons system viability will be another.

VIABILITY

Viability has a direct relationship to career broadening and supplement management and limits assignment latitude out of rated duties. Let me explain. There are some valid reasons why broadening via the supplement is desirable for some officers. These include allowing officers to develop additional professional skills, filling temporary shortfalls in other career fields, providing additional managerial background, providing a broader perspective of the Air Force mission, and affording an opportunity to temporarily undertake careers in new functional areas. While all of these aspects are desirable, a rated supplement can be justified only by using it to bank a rated resource in peacetime that will be available for a wartime contingency. The taxpayers will not provide funding to produce pilots and navigators at a rate that will allow any significant number to leave the cockpit permanently. Besides overall manning, viability draws people back to operations. For example: if we have an officer with 1,000 hours of F-4 time and allow him to broaden into supplement duty and return to operations after a three-year tour, we had a viable resource available for a wartime contingency. With minimum training during that three-year period, we could have requalified him in the F-4 and turned him loose to terrorize the enemy. Having been away for only one to three years, it isn't likely that he lost all the expertise from his prior F-4 exposure. Take that same troop and after his three-year supplement tour allow him to proceed to another supplement tour or assign him to another broadening assignment and he winds up with between six and eight years since last qualified in a mission aircraft. This individual cannot return to the crew force and carry his weight in a combat situation after a couple of simulator rides and a few "over-the-shoulder" instructional sorties. He will require retraining. If we are involved in a heavy conflict, training is not likely to be available because training assets might be converted into operational resources. Essentially, he is lost as a viable asset. The manning situation cannot allow that to happen.

There are some folks in the supplement with pretty heavy credentials in their nonrated career fields who feel they should remain in supplement duty. In all but the most extraordinary situations, they will return to operations upon completion of the tour. The logic of the statement "The Air Force has spent a lot of money on my AFIT master's degree", doesn't begin to compare with the expense involved in sending an officer through UNT, the associated survival schools, RTU, and the initial unit checkout. Officers from the rated resource are among the most expensive Air Force commodities and those in the fighter world are among the most expensive in the rated inventory.

Now that we have discussed viability and briefly touched on the supplement, let's cover the supplement in more detail. During the Southeast Asian conflict and at the height of the navigator shortage, navigators were watching promotion rates and one fact was consistently apparent—navigators in the supplement were getting promoted at rates which far exceeded the navigator or total Air Force average. Immediately, the scramble was on to get into nonrated duty and the competition for a supplement tour became absolutely fierce.

Since the navigator resource was in a severe shortage, it took truly extraordinary credentials to be one of the very few released to supplement duty. As those few were promoted and the percentages were released, the field perceived that supplement duty was responsible for the promotion rates. In reality, supplement duty alone did not increase the promotion potential—

those who had the records to be competitive for supplement also had the quality records necessary for promotion. Career broadening into other than crew duty can be beneficial in demonstrating increased potential; however, broadening can be achieved in operations (i.e., staff duty) as well as in support functions. If an officer moves into the supplement and receives mediocre evaluations he may not increase his promotion potential. Had that same officer remained in operations, perhaps moved to staff and drawn outstanding evaluations, his extensive knowledge of the mission and proven abilities might have improved his lot to a much greater degree. There are those in the WSO force who believe that the navigator cannot compete with the aircraft commander for promotion. Even if this were true, a navigator moving to support duties will face an equally tough or tougher competition. His competition is the support officer with umpteen years experience in his field and an established expert in that which you have yet to learn. He is now your competitor and there are no more "nice guy" 9/4 OERs. It is truly an exceptional individual who can step into any career field and draw top-notch ratings upon arrival.

Let me leave you with some final words about supplement duty. Supplement requirements are projected to decline to the point where they may become a rarity indeed. Many rated officers will never serve in a nonrated AFSC and those who are in support duties now may expect to return to operations upon completing their tours. Occasionally officers have viewed the supplement as a place to salvage a deteriorating career. If your record falls into that category, don't ask for supplement duty. You have to demonstrate that you can hack it in your own field before anyone gives you a chance elsewhere.

BROADENING

Broadening, so far, has been discussed in terms of supplement duty. A more accessible avenue is ops/staff duty. Looking at the fightergator force as a whole, there are a total of around 3,300 fighter, TAC recce, and interceptor requirements on the books for FY 78. Of those, about 2,300 are crew (line jock), training (instructor), and pipeline (student WSO) requirements. That leaves approximately 1,000 spread among supervisory, ATC fair share, and other staff requirements. This equates to 1,000 fightergator opportunities to broaden and those requirements exist at every level from Wing to the Air Staff. Who gets selected for those positions? Those who have demonstrated the potential to assume positions of greater responsibility, i.e., those outstanding performers with the most competitive records.

The term "competitive" has been used several times in the above paragraphs. By now, I know you are thoroughly familiar with the new OER system. Once again, though, let me point out something that is often forgotten; OER ratings are only one part of the total record. PME, assignment history, level of responsibility, academic achievements, and the *words* on the OERs—virtually every item in your selection folder—combine to produce a picture of your competitive standing. One OER does not scuttle a career any more than salvage an otherwise undistinguished record of performance. The total record is considered in any selection for a "competitive" assignment.

So you review your own record, take stock of your accomplishments to date, and determine that now is the time to make that step into a staff assignment. Your question now is, "How do I find out about these opportunities and get assigned to one of those agencies?" Start by reading AFR 36-23, Chap 8, "Navigator-Observer Career Progression Guide."

Let me digress for a moment. While I was at the Center, a tremendous amount of time was spent answering questions about career progression. I discovered that many people who ask questions about assignments and career progression have never read AFR 36-23, or talked to the unit career advisors. My replacement at the Center is still faced with the same problem—folks are asking MPC to provide information that is available locally. Call the Center only you if have a problem that cannot be solved by your organization.

Back to your bid for a staff assignment. Paragraph 8-4 of AFR 36-23 provides a listing of specified career positions oriented by weapons system world. For the WSO, these are 2255X positions. That is only part of the staff picture. The Air Staff, MAJCOMs, numbered air forces, centers, special operating agencies, etc., all have general operations staff (2295) requirements in addition to the specific staff requirements. The positions are there for the man with the qualifications. Put your assignment preferences on your AF Form 90.

Let's talk for just a moment about realistic AF Form 90 preferences. The resource managers must consider many things when accomplishing assignment actions—most important is placing the right man in the right job. Along with this,

they must insure assignment equity to the greatest extent possible. That does not mean that they assign officers only to insure equity. Occasionally a troop from the field will call the Center and state that he should go to a particular staff position because he has more time in crew duty than anyone else. While crew tenure is certainly a consideration when selecting officers for staff, it will not drive a mediocre performer into a key billet.

Probably the most visible factors in achieving assignment equity are overseas and short tour assignments. The attempt is to not assign an officer involuntarily to an overseas or short tour requirement until all officers who are more eligible and qualified for that requirement have served. What does this mean to you? Since a full 50% of the WSO/EWO/staff requirements in the fighter world are overseas, at approximately 2½ years in the CONUS, you become eligible for another overseas requirement. Presently, seven to ten years after your first remote you become vulnerable for another short tour. Once you have two short tours, however, it is unlikely that you would be sent on another unless a contingency breaks out.

This means that if you are in the CONUS and are vulnerable for an overseas assignment, you are not likely to be selected for a CONUS staff requirement. On the other hand, that need not ace you out of a good staff position. As I said before, a full 50% of the requirements are overseas and that applies to staff requirements also. If you are approaching vulnerability for an overseas assignment and possess a competitive record, it may be to your advantage to volunteer for an overseas requirement and go on your own terms rather than sit idly by and let the overseas tour catch you. In effect, the same applies to you who are short tour eligible. If your short tour return date is prior to 1970 (or you haven't been yet) and you have a tactical background you may soon have the opportunity to go. The resource managers are not going to place you in either a CONUS or accompanied overseas staff requirement until you have taken your turn at that remote. Assignments to stabilized tours, supplement, special duty assignments such as ATC, the Academy, ROTC, etc., are not usually excepted. Overseas or remote eligibility can definitely be a constraint, *but only on opportunities within the CONUS.*

For those of you who are currently on an overseas assignment, you may have a better chance at that staff opportunity than your CONUS-based counterpart. Many agencies at NAF and MAJCOM level in PACAF, USAFE, and AAC desire WSOs and EWOs on their staffs who have current in-theater experience. I noted that the in-theater volunteers with outstanding records were often welcomed on staff openings within those commands. In some cases, the individual had to extend for a brief time at his current duty location in order to avoid excessive overlap, so don't dismiss the opportunities that your overseas command offers.

One other factor which directly affects your bid for staff assignments is "gate." A minimum of 108 months gate credit is mandatory and you cannot be considered for a non-gate assignment until you have 72 months of credit (6 years). Six years also roughly coincides with your cockpit DDA. That amount meets the first gate when you are reviewed at the eleven year point. If you receive a nongate creditable broadening assignment with 72 months accumulated, you definitely will be returned to gate creditable duty at a later time. In other words, if you leave the crew force early in your career, you will return to crew duty during your field grade years to meet the remainder of your gate requirements. Some WSOs prefer to accumulate nine years of gate before moving to other than gate duty, thereby allowing them to pursue staff duties throughout the remainder of their field grade years. Some WSOs depart the crew force into nongate creditable duty thinking that they can always get a neat MAJCOM or higher staff position later that will count for gate. A bad assumption! The number of gate creditable staff positions above wing level are few and getting fewer. No, there isn't much of a way around the gate. Our elected representatives in Washington didn't give us that piece of legislation as a neat way of getting flight pay without having to fly for it. They enacted the legislation to insure amortization of an expensive training investment.

Now you have read 36-23, talked to your unit career advisor, decided what you want to do next, and have a blank copy of the AF Form 90 in front of you. What do you put down? If your career advisor is on the ball, he has provided you with a step-by-step guide on completing each block, explaining the significance of each square. Usually, the only problem with an AF Form 90 is that the officer submitting it really doesn't know what information he should include in the remarks section.

You should include additional geographic or base preferences based on educational considerations, rationale about your career plans vs gate requirements, overall priorities

(geographic over the job or vice versa, staff duty over a CONUS assignment, type of aircraft over geographic preference or command, etc.) joint spouse consideration, and anything else that may indicate your preferences. When your assignment is made, the resource managers have a career brief which contains data similar to your UMPR (though in a different format), a copy of your selection folder, copies of any correspondence with the Center, and your latest AF Form 90. So, you can omit data relating to your assignment history, flying time, OER trends, overseas history, academic education, PME, etc. The career manager who accomplished your assignment is from the same weapons system world that you are from. He was handpicked because of his background and record and he does understand the subtleties involved in your assignment history.

In winding up this report, I would like to leave you with some thoughts that were true when I arrived at MPC and are as valid today. The first is a quote from paragraph 101 of AFR 36-23, *Officer Career Development,* "Personnel actions completed in conjunction with this regulation support Air Force mission objectives, maintain maximum operational effectiveness, and improve the professionalism of the officer force. While the individual's aspirations and long-term development are emphasized, Air Force requirements must have first priority." Simply put, MPC will make every effort to honor your preferences, but requirements must be met.

My last comment is a paraphrase of an old career development adage. "So far as you are concerned, the most important job in your career development is the one you have now." Those with the outstanding records get the rewards. Good luck to all of you and "check six."

Major Schmidt was commissioned through AFROTC and completed UNT in 1965. He served in C-130s followed by A-26s at England AFB and Nakon Phanom RTAFB, Thailand, and subsequent F-4 duty at Holloman AFB and Takhli RTAFB, Thailand. In 1973, he was assigned to AFMPC where he became Chief, WSO Resource Management in 1975. He now is a student at the US Army Command and General Staff College, Ft Leavenworth, Kansas.

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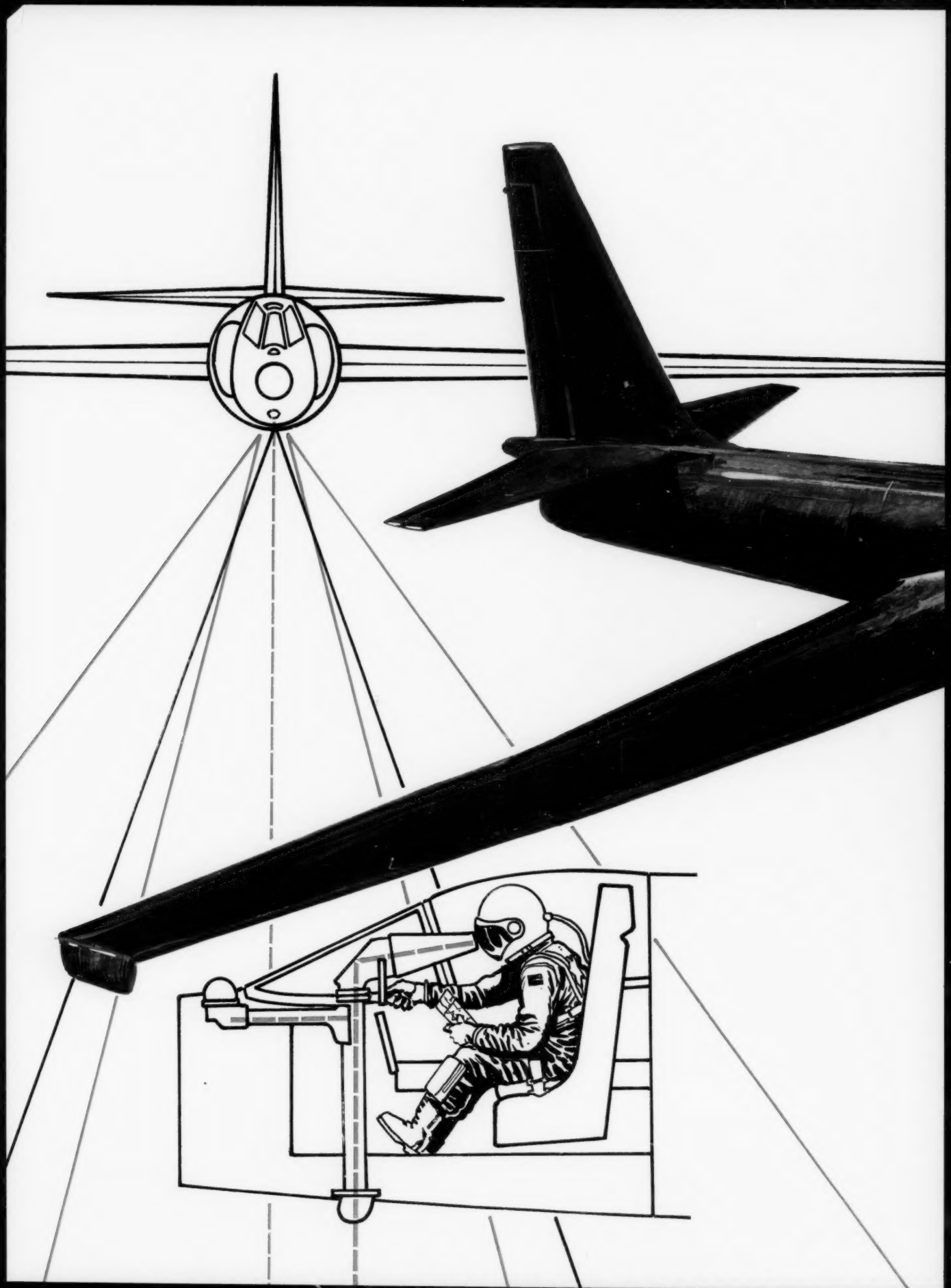
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